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ENVIRONMENT VIEWS

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Letters to the editor are welcomed, and should be sent to the editor,
Environment Views
Alberta Environment,
Communications Branch
12th Floor, Oxbridge Place,
9820 - 106 Street,
Edmonton, Alberta T5K 2J6

Editor:
Maryhelen Vicars
Researcher:
Susan Bramm
Editorial Board:
Jerry Lack, Jim Martin, Dave McCoy, Ray Rasmussen, Chris Staddon, Stephen Tyler, and Bob Westbury.

The editorial board was helped in preparing this issue by Dr. Percy Sims, director of the research management division of Alberta Environment and by Dr. Sherman Weaver, executive director of the Alberta Environmental Centre.

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Alberta
ENVIRONMENT

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Editor's Notebook

CANADIANA
SEP 27 1984

GERRY RASMUSSEN

Wildlife biologist David Moore takes an elevator to the top of Edmonton's AGT Tower to check the progress of a family of peregrine falcons who have a semi-permanent home on a ledge overlooking the river valley.

Dr. John O'Donovan, a weed scientist, spends hours far from test plots and greenhouses, working on computer programs for modelling the economics of weed-crop competition.

Students Noriko Kawaguchi and Jeff McKague don scuba gear and plunge to the bottom of Narrow Lake near Athabasca to sample groundwater infiltration.

Diverse as their activities seem, all are environmental researchers. In the first of our two issues on environmental research, we looked at the structure of environmental research, defining it and describing some of the standards and policy involved.

In this issue, we attempt to look at the work itself. This has been a challenge for us all. There is no shortage of interesting work being done, nor was it hard to find articulate and committed researchers willing to spend time with our writers describing their work. The difficulty was in selecting a few projects which we hoped would fairly represent the scope of the environmental research being done in Alberta.

We hope we have succeeded, not in telling you everything that is going on in this vast field, but in giving you an impression, a sampling, of the research and the researchers involved. We examine work related to land, water and air and look at two multi-disciplinary approaches: The Acid Rain Deposition Program and the research program of the Reclamation Research Technical Advisory Committee. We also look at some of the researchers of tomorrow, young people involved in the science fair program in all parts of the country.

Beginning with this issue, we introduce a new feature of *Environment Views. AE News,* found on page 30, will highlight the activities of Alberta Environment throughout the province. In the form of short news items of general interest, *AE News* will help you become more familiar with the work done by the department and introduce some of the people behind the scenes.

Maryhelen Vicars, a former journalist, is the freelance editor of *Environment Views.*

Gillian Sniatynski

Land-based Research

From soil conservation to peregrine falcons

DAVID CHANASYK

In strictly literal terms, "land" is the solid part of the earth's crust.

In ecological terms, it is a marvellously intricate system of linked elements — soil, water, rock, plants, animals and people.

Research on the land environment incorporates all these elements, and engages people from every scientific discipline.

Dr. Bill McGill is chairman of the department of soil science at the University of Alberta. He was raised on a small mixed farm in southern Manitoba, and speaks of his emotional attachment to the land.

The project he has been managing for the past three years, on conservation of land productivity, clearly has more than scientific interest for him.

The $170,000 project was funded by the Alberta Heritage Savings Trust Fund through the ambitious and multidisciplinary Farming for the Future agricultural research program. It looks most closely at changes over time in the organic content of soils on Alberta farmland.

Organic material is known to store and supply essential plant nutrients, help maintain soil structure (thereby influencing events like water infiltration and root penetration), and help prevent erosion. But as early as the 1920s, researchers were beginning to document losses in organic content — and a corresponding decline in crop yields.

McGill and his assistant, graduate student Elisabeth Reinl, wanted to get a general picture of the status of soil organic matter in Alberta. So with the help of Alberta Agriculture's soil and feed testing laboratory, they selected and analyzed surface samples from 2,000 farm fields across the province.

They also examined in greater depth 8,000 samples from 72 farms in carefully chosen, representative locations. On each farm, samples were taken from cultivated and native sites, and farm management records obtained from the farmer.

McGill's most significant conclusion from the data is that farm management practices are of enormous impact on soil quality. What farmers actually do on their land, in terms of cultivation and tillage practices, makes a big difference — and in some cases may actually increase the amount of organic material in the soil.

"The perception has been that human

Dr. David Chanasyk's test plots at Berwyn, Alberta (left).

Collaring caribou for Dr. Jan Edmonds' field study (right).

ALBERTA FISH AND WILDLIFE

activities will run the land into the ground — it's not necessarily so," he says.

"There's too much doom and disaster. Yes, we may have lost 30 to 40 per cent of organic matter from our soils. But we are not going to lose everything. There's evidence to show we don't have to lose any more."

Dr. David Chanasyk also works in the department of soil science. He too was raised on a farm, and has concerns about soil and farming practice.

But his concern is focused on the Peace River area, and his expertise is not in soil science but in agricultural engineering and hydrology.

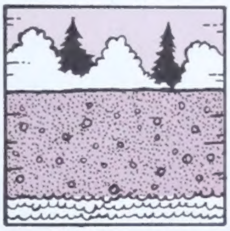
In the Peace River region, fine soils, long gentle slopes and an excess of water make erosion a considerable problem. As part of a $255,000 Farming for the Future research project, Chanasyk set out in 1980 to discover just how much water had to be moved each year and from what sources. He also compared soil losses under different cultivation conditions.

(His experimental plots, at Berwyn and La Glace, were left fallow, or seeded to fescue, canola or barley.)

Chanasyk's project concluded this summer. Among his results and conclusions:

What farmers actually do on their land, in terms of cultivation and tillage practices, makes a big difference — and in some cases may actually increase the amount of organic material in the soil.

- The largest total annual soil losses occurred from the fallow plot, the smallest from the fescue.
- Up to 95 per cent of the total annual soil loss occurred during snowmelt, and the amount was highly dependent on the intensity and rapidity of the melt. This, says Chanasyk, suggests that farmers might have greater control over the erosion problem than they thought, through the use of cultivation practices that reduce runoff.



If farmers in the Peace River country are the main targets the likely beneficiaries of Chanasyk's research, the work of an Alberta Research Council group led by Dr. Brian Hitchon in the Cold Lake area is being done with an eye to oil company operations.

Hitchon too is concerned with water, but the project he manages has — literally — greater depth and breadth.

The $946,000 Cold Lake hydrogeological project began in April, 1982, and will finish in November this year. Funded jointly by the Research Council and Alberta Environment, its major purpose is the collection and organization of a vast mass of information about surface and groundwater deposits in the 24,000-square-kilometre Cold Lake area, and a closer look at the hydrogeology of the oil sands region in particular.

Ultimately, the project will provide scientists with baseline data that will enable them to predict what would happen to the groundwater resource with extensive in situ recovery of oil sands. They will also be able to evaluate the effects of deep waste disposal (much favored by oil companies, and likely to increase with accelerated development of the area.)

The project *hasn't* involved much fieldwork. Hitchon notes that, for example, data from some 3,000 oil company wells had already been deposited with the Energy Resources Conservation Board. It's been more a matter of bringing together information from a variety of sources, and putting it into computer-readable form.

In fact, it's the highly computerized nature of the project that is an added attraction for Hitchon — that, and the fact that he is working with a multidisciplinary team with expertise in many aspects of hydrology, geology and computer science.

Though many of them may never have been near the Cold Lake region, their pooled knowledge has provided an amazingly detailed picture. In the oil sands region, says Hitchon, "we know how much water is flowing between the rock units, and we know the relationship of that flow to the flow in the potable ground water."

BILL MCKEOWN

Jan Edmonds

At this stage of the study, with that sort of detail, it's possible to conclude (provisionally anyway) that deep well disposal is unlikely to affect the near-surface groundwater.

Jan Edmonds has spent a lot of time in the last four winters in the forested foothills east and north of Grande Cache, using snowshoes, skidoos and helicopters for transportation, and occasionally camp-

Mountain monitoring

DON PROSSER

FORT STEELE HISTORIC PARK ARCHIVES

At 4:10 a.m. on April 29, 1903, millions of tonnes of limestone on the east face of Turtle Mountain in southern Alberta slid into the Crowsnest Pass below. Seventy people in the town of Frank were killed, and the entrance and surface workings of the Frank coal mine were buried.

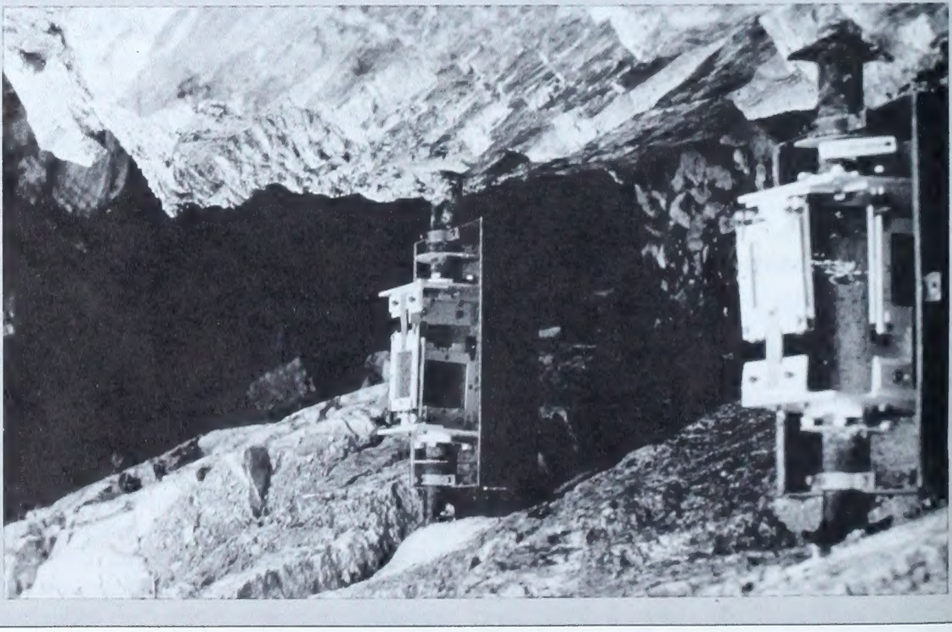
Various contemporary investigations attributed the slide to the structure of the mountain, but everyone recognized that the underground coal mining at the base of the mountain was probably a contributing factor.

Nobody expects a repeat of the Frank slide disaster, but the fact remains that some 1,900 people live in the shadow of Turtle Mountain, in the nearby towns of Hillcrest and Bellevue. And while a rock slide can't be prevented, it is hoped that with today's technology it can be predicted in time to save lives.

Continuing concern about the effects of the extensive tunnels at the base of the mountain was one factor prompting Alberta Environment's earth sciences division to set up a study of the mountain in 1979.

Before then, the only attempt to monitor its state was a 1933 network of paintmarks on the fissures near the crest. Distance between the marks was measured annually to detect movement.

This system has now been boosted by



DON PROSSER

some $200,000 worth of research and highly sensitive equipment capable of detecting submillimetre movement.

The crack monitoring network has been modernized by the addition of measuring devices on some of the major cracks: "strain gauges" which indicate movement by means of interference patterns between sets of finely etched glass plates rigidly attached to opposite sides of the crack; and a similarly placed series of eye bolts whose distance apart is measured by an instrument called a tape extensometer.

Two remote monitoring systems have also been installed. The first is a series of 25 photo targets bolted to the rock near one of the major peaks. A sophisticated computer program is able to analyse aerial photographs taken from different angles and at different times. Changes in the position of any target in relation to the others can be detected to within a centimetre.

In the second remote system a burst of light is fired from a laser instrument at a number of mirror prisms set on both sides of a crack. The time taken for the light to bounce back is used to calculate distances between the prisms —which in turn indicates whether there has been movement of the crack.

Accurate as it is, though, all this equipment is very localized.

"The only practical way to monitor the whole mountain is to listen to it," says Don Prosser, a geologist with the earth sciences division and co-ordinator of the study.

So one seismic recorder has been set up at the south end of the mountain, and three more are destined for the east face, south of the slide area.

Data gathering in general takes place twice a year. For people involved in the study, that used to mean a long hard climb up the mountain, invariably in wind and fog, with a fair weight of equipment in everyone's backpack. Now, says Prosser, "we have discovered the joys of helicopters."

The Turtle Mountain study has involved historical as well as scientific research. An archival inventory of all the scientific documents relating to the mountain and the 1903 slide was completed in 1983.

While working at the provincial archives, Prosser discovered a complete set of plans for the mine workings in the area.

He discovered that post-1903 mine workings extended about 2,000 metres further under the mountain. Given the probable role of mine tunnels in the 1903 slide, it's easy to justify keeping a watchful eye on Turtle Mountain.

— Gillian Sniatynski

The town of Frank and Frank Slide (left inset).

Sophisticated crack monitors installed in a fissure on Turtle Mountain (left below).

ing out in cabins loaned by trappers.

Edmonds is a wildlife research biologist with the Fish and Wildlife Division of Alberta Energy and Natural Resources. She is studying the mountain caribou of west central Alberta, and her work vividly illustrates the fragile balance of relationships between animals, plants and the land.

The Fish and Wildlife Division mounted its caribou study in 1979, after one of the biggest forestry leases in Alberta history was awarded in the Grande Cache area to British Columbia Forest Products.

It was already suspected that the mountain caribou would be especially vulnerable to the sort of environmental changes logging would cause. For one thing, though nomadic and migratory, they have certain favorite areas to which they return faithfully — and the forest around Grande Cache, prime for logging, is where they like to winter. They also need a *lot* of range, because their winter diet staple is a lichen which is found in mature forests and takes from 50 to 80 years to regenerate. They are at risk too, from hunters, poachers and predators. And a low reproductive rate makes it difficult for them to build up their numbers in the face of such environmental onslaughts.

The study's aim, then, was to determine the status of caribou populations in the Grande Cache area, and to assess the effects of extensive timber harvests on their winter range.

When Edmonds became the project's field biologist in December, 1980, she started data-gathering from the air and on the ground.

It's estimated that the 275 or so mountain caribou that winter in the Grande Cache area have a combined total winter range of some 13,000 kilometres.

Because they roam so widely, 21 were captured and fitted with radio transmitter collars. Not all the collars worked, but, says Edmonds, a total of about 12 animals a year were tracked by air at least twice a month for the four years of the study.

(On this project, at least, the biggest cost has been flying time — about $34,000 a year from a budget seldom bigger than $50,000 in a busy year.)

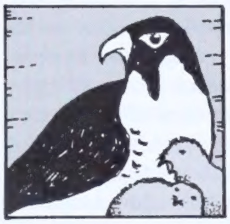
An army of temporary helpers worked on the ground surveys. For Edmonds, a useful side benefit of the study was that "a lot of people got some wildlife experience."

For four winters they followed the caribou daily, checking areas where some activity could be expected, following tracks, noting vegetation disturbances, and, collecting samples of caribou feces to confirm by analysis what they had been eating.

The air tracking and the ground data have enabled Edmonds to get a picture of the diet and migratory habits of the mountain caribou, and, more importantly, to work out some ways in which logging companies could accommodate their needs.

She took part in meetings last summer with British Columbia Forest Products and the Alberta Forest Service. The company agreed to modify its traditional methods by cutting smaller tracts at a time and allowing a longer time between rotations — to give the all-important lichens a chance to grow.

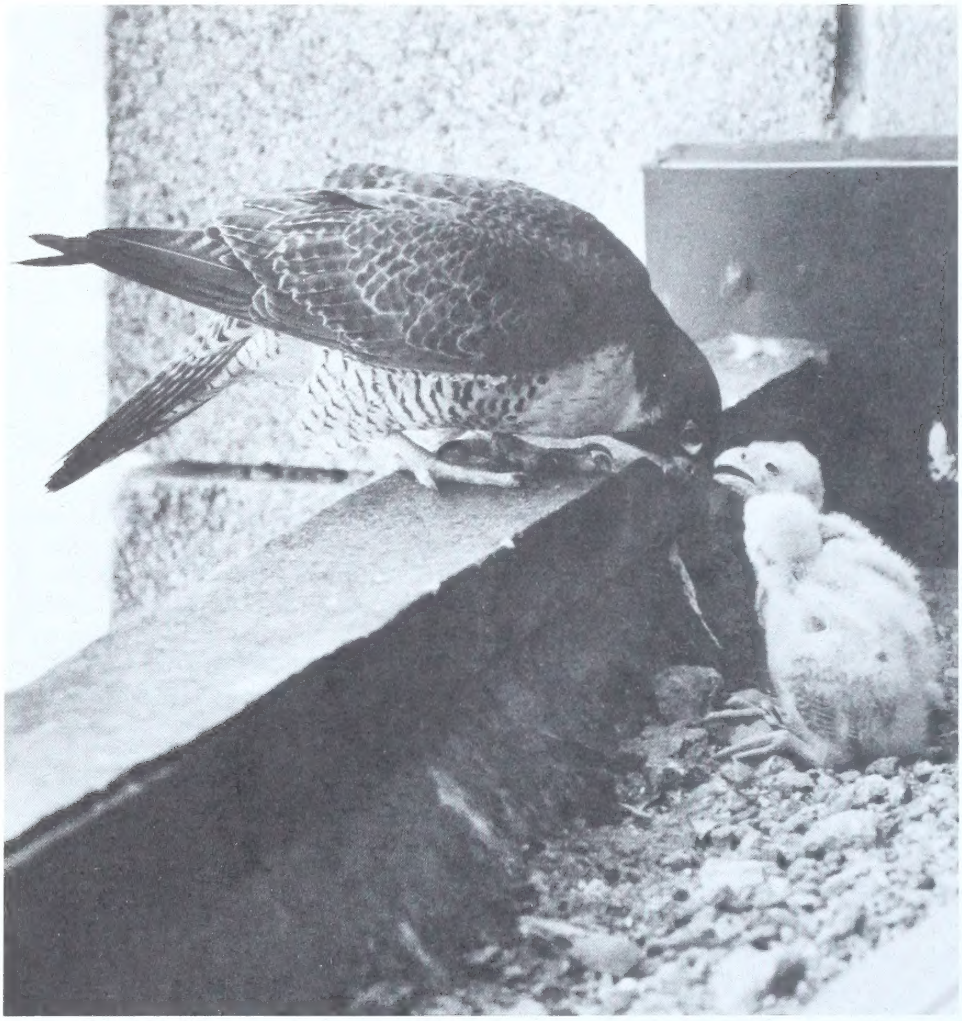
But the happy ending now seems in doubt. BCFP's financial troubles inevitably invite speculation about its future in the area and the value of Edmonds' hard-won agreement.



Doubts and disappointments are not unknown in another Alberta wildlife research project involving peregrine falcons.

Before 1945, the peregrine population was common along most of the main river valleys in Alberta. Then there was a drastic drop in numbers — due, it was later discovered, to the widespread use of pesticides (especially DDT). The toxic accumulation in their bodies caused the females to lay eggs so thin-shelled they were easily cracked. By 1972, when legislation in North America had prohibited the use of DDT, there were fewer than half a dozen breeding pairs in the province.

The peregrine falcon program was started jointly in the early 1970s by the Canadian



Peregrine family on a ledge of Edmonton's AGT Tower (left).

DAVID MOORE

BILL MCKEOWN

David Moore

Wildlife Service and the Alberta Fish and Wildlife Division. Its aim was to maintain the gene pool, to develop means of raising the birds in captivity and to find the best way to release them. They wanted to boost the natural production of the few remaining wild peregrines (found in the far north-east corner of the province), and to release birds raised in captivity to traditional nesting sites along the river valleys further south.

Fish and Wildlife biologist David Moore says that efforts to supplement the wild production involve two techniques: "double clutching," in which the first clutch of eggs from a pair of birds is removed after incubation, allowing the pair to re-nest and produce a second clutch; and fostering, in which captive-reared young are introduced to wild nests. Moore says both techniques have been tried successfully in northern Alberta, where there are now at least six, and possibly eight, breeding pairs.

There are also captive-raised birds returning to breed in Edmonton and Calgary (where high rise buildings close to river valleys provide a satisfactory substitute for the cliffs they choose for nesting in the wild).

One of the program's triumphs is its success in captive breeding.

"When we started it was felt that it couldn't be done," says Richard Fyfe, a research scientist with the Canadian Wildlife Service and one of the program's prime movers.

From the first breeding success in 1972, he says, "we can probably put out a hundred or more birds a year now if we really put our minds to it."

Costs for the whole program, for the two agencies involved, would be hard to figure. But Fyfe does estimate that the total cost of raising a single peregrine falcon in captivity is about $1,800.

If that seems to be a large expense, it must be remembered first of all that the Canadian Wildlife Service breeding facility at Wainwright produces birds for other provinces too. And a large number — David Moore's estimate is 70 per cent — never survive their long migration south.

The program aimed at releasing captive peregrines to new breeding sites is in limbo at the moment — and that long migration is the reason. Unlike the peregrine falcons of eastern Canada, which may fly only as far south as Florida for the winter, the western population flies into South America. And in the tropical and subtropical regions, DDT is still used for such purposes as malaria control.

"(The birds) continue to be exposed to high residues," says Fyfe.

"Mainly what we have been doing in Alberta is fighting a holding action. We're getting birds into the area and pumping the young back, but there's very little chance that they will take off for full recovery unless the residue levels are down."

Fyfe refuses to feel disappointment, however. What he's doing, instead, is making long field trips to the Latin American countries, hoping with the help of wildlife experts there to pinpoint the source of the pesticide problem.

And there *are* some great moments. David Moore talks about the thrill of focussing binoculars on a returning bird and recognizing the number on its leg band, realizing that "some birds you have been involved with made it through two migrations and actually made it back..."

Emotional attachments to the subject may be less likely in plant research. Indeed, the subjects of Dr. John O'Donovan's work at the Alberta Environmental

Plantscapes

Increasingly indoor plants are taking over in the places where we live, work, and shop.

In all those places, indoor plants are becoming more numerous and conspicuous.

So, in all likelihood, are the mealybugs, the aphids and whiteflies.

Marilyn Steiner is an entomologist with the crop protection group at the Alberta Environmental Centre at Vegreville. She is also a keen and thoughtful gardener. In about September, 1980, she recalls, she attended a meeting of greenhouse operators in southern Alberta and heard a talk about biocontrol of greenhouse (specifically cucumber) pests.

Biocontrol involves the use of living organisms to control other, less desirable, living organisms. Steiner wondered about its potential for indoor plantscapes, and having located a severe mealybug problem at the Muttart Conservatory in Edmonton, outlined a plan of action there.

MARTHA JONES

Work started in May, 1981, in the tropical greenhouse where the warmer temperatures make biological control easier. She labelled about 80 plants, and counted the bugs every week, getting "some pretty funny comments from the public" as she did so.

Predators were introduced on a schedule — a predatory mite to attack spider mites, an Australian ladybug beetle for the mealybugs, a species of wasp for the whiteflies, to name just a few.

The program has now been extended beyond the tropical pavilion (the Australian ladybugs apparently had a fine time pursuing the mealybugs around the cacti spines). The Muttart staff have now taken over its operation (at a cost of about $3 a square metre a year). And Marilyn Steiner, with Don Elliott of Agriculture Canada's Saanich research station in Sidney, B.C., has written a useful handbook (available from the Vegreville centre) called "Biological Pest Management for Interior Plantscapes."

Steiner notes that biological control isn't intended to replace chemical pesticides. Regular monitoring and spot spraying are important aspects of an integrated pest management program.

There are some drawbacks. Biocontrol needs a fairly large atrium to work successfully. And it won't work at all without a reliable supply of the appropriate predators.

— *Gillian Sniatynski*

Centre in Vegreville are generally considered unlovely and unwelcome.

O'Donovan is a weed scientist, probing the complex relationships between weeds and the crops they infest. Specifically, he's interested in weed-crop competition, the fight for nutrients, water and light staged in farm fields across the prairies.

"Weeds, like other plant pests, have a considerable impact on the environment," he says.

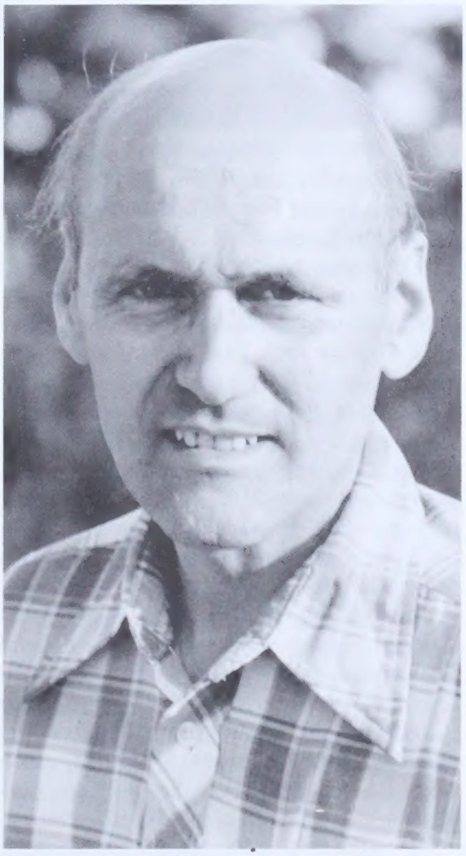
"But unlike other pests, the effect of weeds doesn't seem so dramatic."

There's drama enough, though, when the problem is put in terms of money. O'Donovan says that in the United States, annual crop losses due to weeds are estimated at $12 billion, and control of weeds costs another $16 billion.

It's really on the question of control costs that his own work turns.

"Over the years there has been considerable research by weed scientists to develop and test a wide variety of herbicides, to achieve the best possible control of a wide spectrum of weeds," he says.

"This research has been super in controlling the weed problem in general. But there has been less research on developing sound quantitative information to justify the economics of applying some of these herbicides in certain situations. We need this information in order to make intelligent decisions about the use of herbicides."


SUSAN BRUN

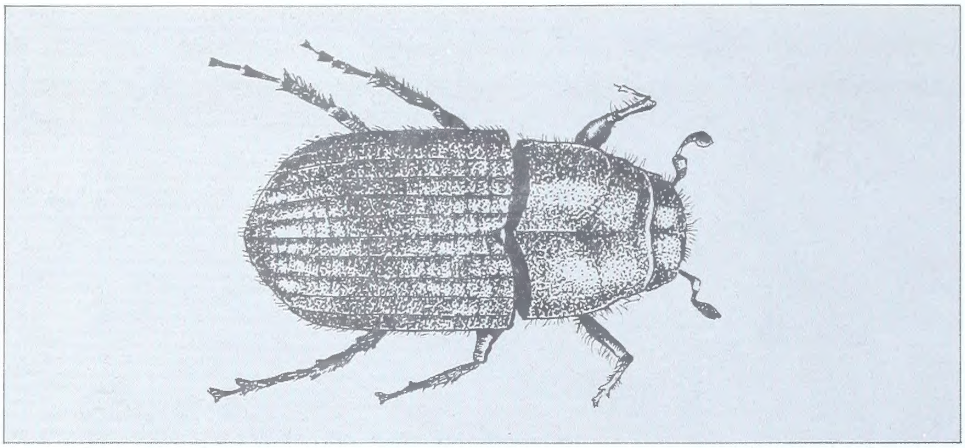
Hal Wieser

Farmers need to know what level of crop losses warrant the often considerable investment in herbicides needed to kill the weeds.

Most early research on the problem was on the wild oat, and mathematical models were available to help farmers predict crop losses from different densities of the weed. But there was little information about the effect of factors other than density — or about other weeds.

O'Donovan came to the Alberta Environmental Centre from the Agriculture Canada research station at Lacombe in January, 1983, and still works closely with the scientists there. Their co-operation has now produced a mathematical model to predict losses of wheat and barley to wild oats based on the time of the weed's emergence. (In general terms, the earlier in the crop's life the weeds appear, the greater the likely losses.)

And all sorts of other experiments are on the go. To determine the effect of factors like soil moisture, nutrients and temperature on relative weed and crop growth, O'Donovan has set up laboratory-type experiments in environmentally controlled "growth chambers." There are also outdoor field experi-



MARTHA JONES

UNIVERSITY OF CALGARY

Dr. Elisabeth Dixon, a University of Calgary chemist who works with the mountain pine beetle (above).

ments at Vegreville and Lacombe. Weeds such as green foxtail, smartweed and stinkweed are being studied, as well as "volunteer cereals", the unwanted wheat or barley residues from an earlier seeding that can become a nuisance in canola.

One long-term experiment is looking at the reinfestation potential, over several years, of a small quantity of wild oats left untreated in a crop.

Dr. Hal Wieser of the University of Calgary's department of chemistry is tackling another problem of the plant world. The victim of the piece is the lodgepole pine. The villain is the mountain pine beetle which burrows under its bark, and in sufficient numbers (perhaps because of a fungus it carries) ends up killing the tree.

Though there has always been a small resident population, the ranks have been swelled by visitors blown in from B.C. and the U.S. Now the beetles are a serious problem in Alberta's southern forests. And, says Joe Soos, director of the Alberta Forest Service's Forest Research Branch, they are difficult to get rid of.

For one thing, even if pesticide use were desirable, it wouldn't work, because the beetles are buried out of reach under the tree bark. Until recently the only options were to do nothing and let the trees die, or cut down smitten trees before the infestation spread.

Wieser and his colleague Dr. Elisabeth Dixon, another University of Calgary chemist, entered the picture in 1982. They were interested in chemical communication (Wieser particularly in the way a chemical's molecular vibration relates to communication). And they happened to have synthesized a close approximation of the natural pheromone or attractant given off by the mountain pine beetle.

Wieser and Dixon wanted to test the efficacy of their compound by trying to catch some beetles. And the Alberta Forest Service badly wanted to catch some beetles.

With the help of Dr. Herb Cerezke of the Northern Forest Research Centre of the Canadian Forest Service, a small pilot project was set up in the summer of 1982, with favorable results. Last year, it was expanded, with even more success.

The synthetic pheromones were used in two ways: to lure the beetles into traps (135 in all) containing a soap solution which killed them; or to attract them to tree "baits." On the 21 baited trees the synthetic pheromones attracted a number of beetles which then exuded their own natural pheromones and continued the job.

"The tree you bait that way becomes an absorption tree," says Wieser. "You can draw beetles in specific locations marked for logging."

Last year's grand total of some 30,000 beetles was sufficiently encouraging to warrant testing of the compound on an even larger scale this year. About 60 traps will be used, but there will be greater emphasis on tree baiting.

The project has been funded for three years by the Alberta Environmental Research Trust and for two by the Alberta Forest Service, each to a tune of $35,000 annually. From all accounts it's been money well spent. And for Wieser, there are some particular satisfactions.

In the science of chemistry, his particular area is something highly specialized and exotic called vibration spectroscopy.

"All the time in my graduate years I thought, my gosh, what is it all for?" he recalls.

Now, for the first time, there's a glimmer of an answer.

"I am by training and inclination a physical, fundamental scientist. What I am really keen about is that I can see an end product, a direction where my little bit of science can have some application...

"I have an advantage over many other people in my field in that I can meddle in the real world. I can sit at a conference table with a forester, and we are both concerned with the same problem."

Gillian Sniatynski, the former editor of this magazine, is now a freelance writer and editor living in Drayton Valley.

Ronnene Anderson

The Water Environment

Studying Alberta's waters and the plants and animals within them.

Technician using stream gauging equipment to measure river flow

B TREVOR

Dr. Jim Moore has lived and conducted environmental research in England, France, eastern Canada and the Canadian arctic, but Alberta keeps calling him back.

"Whenever I return from more industrialized areas of North America and Europe, I'm happy to get back where the air and water are nice and clean. Most of Alberta is reminiscent of the pristine conditions of the Canadian arctic and subarctic."

Moore, head of aquatic biology at Alberta Environmental Centre in Vegreville, is among the government and university scientists whose water-related research projects are profiled here.

While the projects vary widely in subject — from fish ladders to pulp mill pollution — they have aims in common: preserving Alberta's relatively pure water and the plants and animals within it; and understanding how water behaves under various conditions.

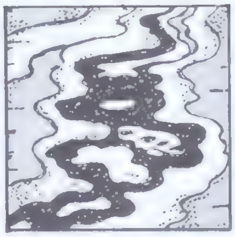
The scientists range from hydrologists to biologists to limnologists. Their beneficiaries include bridge builders, lakeside developers, fishermen, swimmers and government regulatory agencies.

When man-made contamination occurs, some of these researchers team up with industry officials to find the source. Dr. Malcolm Wilson, another Vegreville scientist, says there is a tendency in Canada, as in Britain, to "foster co-operation between government and industry to solve problems."

Moore adds: "We're not overregulated, like the U.S. is. They went regulation crazy... In Alberta, the government has struck a nice balance. I have no hesitation to boat and fish in Alberta's waters. I'd have considerable hesitation to do that in many lakes and rivers in Ontario, or Quebec, or parts of the eastern United States."

It is significant, says Moore, that the two chemical residues he is currently studying in Alberta fish are probably not from man-made sources.

Alberta Environment's recent two-year investigation of mercury residues prompted the government warning against eating more than one meal a week of fish caught in Alberta's southern rivers. The mercury is believed to occur naturally in the soil.



Now, Moore is stalking another group of toxic chemicals: polycyclic aromatic hydrocarbons (PAH), organic compounds found in the oil and grease seeping from tar sands along the Athabasca River.

"The levels of oil and grease in the Athabasca River, from entirely natural sources — and you can underline natural — are probably higher than anywhere in Canada," Moore says.

Some PAH compounds, like benzopyrene, are carcinogenic. And high concentrations of PAH in laboratory animals are implicated in damage to the spleen, thymus, lymph nodes and bone marrow.

There is no evidence of PAH poisoning in Canada, but Indians at Fort MacKay, who regularly eat fish and drink water from the river, have complained of symptoms of oil and grease consumption, including nausea, vomiting and diarrhea.

Moore's group has analyzed the tissues of about 60 Athabasca walleye, northern pike, sauger and goldeye, using a sensitive technique called fluorescence spectrometry. Preliminary data show the presence of some PAH compounds, and the researchers are now trying to identify them.

"If we find low levels (of PAH), the study will be terminated after two years," Moore says. "But if high levels are found, I would anticipate studies on the source." Canada has no safe PAH standards for fish, but Moore's department plans to work with the research centre's toxicology group to establish mammalian toxicity.

The mercury work will also continue, this time on Alberta's central and northern rivers, including the Peace, Wapiti, Athabasca and Smoky. During the next two years, fish tissue samples will be ground into a paste and nitric acid added to digest all organic material. The mercury will be extracted from the acid and aspirated into a mercury monitor.

The earlier mercury study on southern

Zoology students Noriko Kawaguchi and Jeff McKague at Narrow Lake (right).

Noriko Kawaguchi with equipment used for taking sediment cores (far right).

rivers, including the North and South Saskatchewan, Oldman and Bow, showed concentrations between 0.5 and 0.7 parts per million. The mercury standard in Canada is 0.5 ppm.

Moore says the mercury found in Alberta's soil probably is a residue of past volcanic activity in the Rocky Mountains. "The theory we have is the movement of glaciers over Alberta has redistributed the mercury onto the glacial plains here. These mercury levels have probably been in these fish since the glaciers retreated."

Alberta is "really a clean province," Moore continues. "Mercury has never been used extensively in Alberta industries, except for seed fungicide, and that practice was discontinued more than a decade ago."

"The theory we have is the movement of glaciers over Alberta has redistributed the mercury onto the glacial plains here. These mercury levels have probably been in these fish since the glaciers retreated."

So why test for mercury or PAH if they occur naturally and nothing can be done about them?

"I guess skeptics will not believe us, and I can certainly see their point of view," Moore says. "Governments have been known to withhold studies to protect industry... If I were a taxpayer, I'd want some sort of study done to alleviate public concern and political considerations."

This summer, three tests are being conducted to confirm whether the mercury is natural or not. First, the researchers will take 200 sediment cores from 20 to 25 lakes, reservoirs and rivers in southern Alberta. "We'll try to get sediments back to about 500 years ago," Moore explains. "We believe that as we go deeper, the mercury levels will

Continued on page 14

Plumbing the depths

RONNENE ANDERSON

Rain is imminent, but zoology students Jeff McKague and Noriko Kawaguchi hop in their motor boat anyway and roar across the water.

Their worksite — the isolated Narrow Lake near Athabasca — appears untouched, but somewhere out there are marked water sampling sites and sediment traps. The students know exactly where to go.

"We have to go out rain or shine," says McKague, who will start his fourth year at the University of Alberta. "One time we went out to collect water samples and there was ice in the boats. It was May."

Still, he and Kawaguchi consider themselves lucky to have summer research jobs with U of A professor Ellie Prepas, a limnologist studying what controls productivity in lakes.

Prepas and her fellow professor Bill Mackay, an environmental fish physiologist, are tackling a brand new research area in the province: determining the sources of lake water, the nutrients they carry, and the role of lake sediments in regulating nutrients.

Without this information, water managers cannot estimate the impact of a new lake development, find sources of pollution, control algae that discourage swimmers or discover why some lakes have fish and others don't.

Prepas is spending much of her summer at the Meanook Biological Research Station, a 10-building complex of refurbished laboratories and living quarters that the university recently inherited from the Canadian

RONNENE ANDERSON

Wildlife Service.

The station, nestled in peaceful woodland about 15 kilometres south of Athabasca, is a 20-minute drive from the focus of current research, Narrow Lake. Prepas says: “The idea is to make a really strong centre for field biology in Northern Alberta, (fostering) co-operation with the Fish and Wildlife Division and various divisions of Alberta Environment. The university has a few other field stations, but “nothing like this,” she adds.

McKague and Kawaguchi live at the station, dormitory-style, with about 10 other scientists, technicians and students. Their hours are long, their weekends spent working, but it’s worth it. McKague says the job “gives us a really good look at field science, which is totally different from classroom science. And that in itself is really invaluable in making career decisions.”

Later, the two students will put their scuba training to use and dive to the lake bottom for groundwater samples. Groundwater, which is surface water that has seeped through soil and accumulated in underground reserves, is a key element of Prepas’ research; she calls it “the huge unknown.”

Most Canadian lake research has been done in the east, where lakes lie in sealed rock basins, and where water sources are easily identified. But in Alberta, especially central Alberta, lakes are in glacial till — sand or clay — which allows interchange with groundwater.

“The problem is, as of 1984, we can’t quantify where the natural and man-induced imputs are coming from because almost all the work has been done on granite — rock basins,” Prepas explains.

Two nutrients known to control plant growth in lakes are phosphorus and nitrogen. Groundwater can pick up these nutrients as it trickles through the soil. If it runs through an area with sewage, for example, then it may pick up nutrients from that as well.

“Nobody has sorted out what happens to nutrient levels in groundwater as it percolates through lake sediments and into the lake, and we’re in the process of determining that.”

With answers, researchers can concentrate on controlling levels and ratios of phosphorus and nitrogen, and perhaps eliminating excessive weed growth and those “nasty blue greens”, the dominant summer algae in Alberta’s lakes.

Prepas cites Lac La Nonne northwest of Edmonton, where “you get huge algal mats decaying at the edges, and smelling. People really don’t appreciate going swimming in mats of algae.”

It is possible to have a phosphorus problem from natural sources, but Prepas says “in most cases human beings have exacerbated already nutrient-rich aquatic systems.

Randy Shaw, Prepas’ graduate student, is in charge of measuring groundwater inflow and outflow. He has placed about 75 plastic pails, called seepage metres, in Narrow Lake sediments, and attached plastic bags to collect water. He’s also inserted a couple of dozen sets of plastic tubing, called mini-piezometres, in the sediment and extended them above the surface. “If the water level extends above lake level, it indicates groundwater inflow,” Prepas says.

Another graduate student, Jackie Bierhuizen, handles the sediment-lake nutrient interactions. To collect organic material falling from the lake surface, sets of three plexiglass cylinders are lowered by rope deep into the lake. “Pore water “peepers,” or sets of plexiglass chambers, are placed on lake bottom, to trap nutrients coming in with groundwater and those returning to the lake from the sediments.

Back at the field station laboratory, the researchers examine water and sediment samples to determine nutrient concentrations.

The scientists will also measure surface water inflow and precipitation. “We’re trying to make a nice story for Narrow, and then branch out to other lakes,” Prepas says.

Her research is financially supported by Alberta Environment and by a small grant from the Alberta Recreation, Parks and Wildlife Foundation.

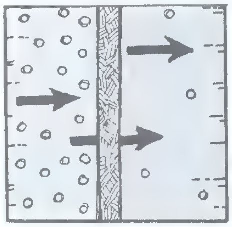
— Ronnene Anderson

SUSAN BRUN

Jim Moore

remain constant, indicating a natural source.

They will also look at the strength of the chemical bond between the mercury and sedimentary material, and measure the isotopes (atomic weights) of the mercury, all of which are clues to the source.



In 1982, several hundred Edmontonians were struck with giardiasis, an intestinal infection caused by the one-celled parasite Giardia lamblia. Suspicion centred on the city's water treatment system. Were the giardia slipping through the filters?

Prompted by that possibility, Dr. Steve Hrudey, a professor in The University of Alberta civil engineering department, began supervising a pilot scale project in his laboratory to see if "rapid sand filtration and chemical coagulation" — the process used by Edmonton and most prairie municipalities — does in fact remove giardia-sized particles.

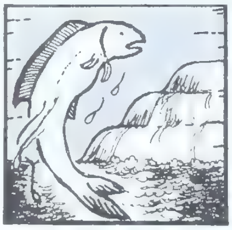
The one-year, $20,000 study is being run by Hrudey's graduate student David Kellendonk, a master of science candidate. To represent giardia, Kellendonk uses five-micrometre diameter latex beads, treated to simulate the parasite's properties, including a negative electrical charge.

Kellendonk sends a known amount of beads through the treatment process and counts them when they come out. Alum and lime, chemicals used by the Edmonton plant, are added in different concentrations to see how effectively they coagulate fine particles. The bigger the particle, the easier it is for the sand filter to remove it.

"If they can get through our pilot scale under optimum conditions, there is a reasonable chance they could get through the city system," Hrudey says. "The traditional wisdom is that rapid sand filtration and chemical coagulation, followed by disinfection by chlorine, should be adequate for protection against giardia outbreaks."

Hrudey stresses that the optimum chemical dosage depends on concentrations of other chemicals already in the water, such as carbonates, bicarbonates and sodium. "If we find out you have to use 100 times (the amount of) chemicals as the city does, we'd run into an economic problem. But I don't think that will happen."

Hrudey hopes the study will lead to similar testing on full scale at the city plant.



Bryan Kemper is a fisherman. His children like fishing. It is no surprise, then, that he takes a personal as well as professional interest in his search for a better fishway.

Kemper, a biologist in charge of the environmental assessment section of Alberta Environment's planning division, says most fishways, or fish ladders, in the province have failed in their task of helping fish pass around weirs and irrigation dams. At risk are valuable commercial and sport fisheries.

"As Alberta develops its water resources, if we don't have a usable fishway, in 10 or 15 years there will be so many impediments to fish migration that highly mobile populations will find it impossible to exist. Their habitat will be gone."

BILL MCKEOWN

David Kellendonk

Kemper says the fishways were imported directly from British Columbia, and tended to be shunned by the slower-moving fish of Alberta's warmer waters. They also have been poorly placed.

An example was Kemper's first target of study, the "step-and-pool" (graduated ascent) fishway at Fawcett Lake in central Alberta, where outlet flow is regulated by a weir to stabilize lake levels for waterfowl, fisheries and recreation.

Studies in 1981 showed walleye, northern pike, grayling and whitefish were not moving upstream into the lake, but spending the summer below the weir where they were susceptible to fishing. "They were just like sitting ducks," Kemper says.

The problem? When the fish reached the turbulent impassable water below the weir and searched for a way around it, they couldn't locate the fishway entrance because it was too far away.

Kemper and his colleague, hydrologist Dieter Lindner, set to work on a new fishway based on the American Denil II, a system of baffles, or plates, that eliminates the need for jumping. They left the existing fishway's outer structure intact, installing switch-back channels to bring the entrance from 20 metres to within two or three metres of the velocity barrier below the weir.

Improvement was immediate. "Instead of passing only 0.2 per cent of the northern pike, we passed four per cent. We felt if we could pass the pike, which were probably poorer swimmers than the other species present, that we'd have a successful design."

(A typical counting procedure is to set up net traps below a weir and tag the fish, then catch them in another trap at the fishway exit.)

Later, the researchers placed the Denil II fishway deeper in the water, increasing the "attraction" water at the entrance and ensuring a continuous flow during low lake levels. Now, more than 10 per cent of the northern pike are swimming into the lake.

Ten per cent may not sound impressive, but Kemper stresses that many predatory fish stay below a weir not because they cannot move upstream, but because they prefer to forage on the small fish that are swept over. "We're not at the moment concerned with increasing passage through the fishway, particularly after the spring spawning runs," Kemper says.

This year, the new fishway design achieved more successes at Lesser Slave Lake. Fish were given a choice of three parallel fishways around a new weir: two Denil IIs at different slopes; and one vertical slot, a pool-type fishway with interconnected slots. After monitoring from May 20 to the end of June, the researchers discovered the fish selected different fishways depending on water level, and that even the tiny spot-tail shiners were getting through — 100,000 of them.

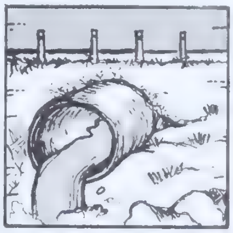
"We know now that even 9-centimetre fish can ascend, if they are given the right fishway. We always wondered whether we were selecting for large fish with better swimming performance, and selecting against the smaller fish."

In Kemper's next study area, the remote Peace-Athabasca Delta, the new fishway design is already passing goldeye — a rare accomplishment. Goldeye usually swim in schools, Kemper explains, and some schooling fish are reluctant to enter fishways alone.

BILL MCKEOWN

Bryan Kemper and Dieter Lindner

"I believe this is the first time in Alberta that we've successfully passed goldeye," Kemper says.



For the last 10 years, hydrologist Alex Harrington and his crew have been wading into streams, driving posts into sediment and catching dye-stained water.

Despite the odd beaver dam that thwarted water level measurements, they have now plotted flood-frequency curves for 43 stream sites in north central Alberta, from Peace River to Fort McMurray.

This information is vital for government engineers trying to choose the right size culvert or bridge for small streams. "You can build something much too big, and it would cost way too much, or you can build something much too small, and have it washed out," says Harrington, manager of the hydrotechnical section of Alberta Research Council's civic engineering department. "We would like to reduce the uncertainty."

Harrington gives a textbook definition of hydrology: "The study of the distribution and occurrence of water." He calls his project "small watersheds," because it examines pieces of land under 250 square kilometres that produce the water that passes under a bridge or through a culvert.

Harrington's group worked mainly near existing culverts, measuring velocity with current metres, and flood peak levels with crest gauges — three-metre high posts driven into the middle or sides of a stream. The posts carried a graduated rod with a dye-painted tube, so the researchers could monitor the level of dye as it was washed away. To determine amount of flow, they placed red dye in the water and measured the concentration downstream.

The results now can be related to other areas of the province with similar basin size, slope, drainage density (number of tributaries), land use and terrain.

People can say 'with this slope, land use etc., we can expect discharges of this magnitude,'" Harrington explains.

The study will also provide land developers and government officials with predevelopment stream flow information that will help prevent environmental disruption. "We didn't set out to do that," Harrington says. "That's a side benefit."

BRYAN KEMPER

Installation of a Denil II fish ladder (left).

Sediment dating using a Vibra corer to sample bottom sediments in Glenmore reservoir (below).

HENRY HUDSON

An unnatural dark stain courses through the Wapiti River in Western Alberta; Dr. Malcolm Wilson is looking for ways to eliminate it.

Wilson, head of environmental technology at the Alberta Environmental Centre in Vegreville, says the treated effluent from the Procter and Gamble kraft pulp mill in Grande Prairie can be seen as far away as Peace River, about 20 kilometres downstream in the Wapiti-Smoky-Peace River system.

The discharge is "almost black, very, very dark brown," Wilson says.

Procter and Gamble and the other pulp plant in his study, St. Regis Alberta Ltd. on the Athabasca River at Hinton, are both within provincial and federal discharge standards, and use highly-regarded pollution abatement practices, Wilson says. Health risks have not been linked to the discharge.

"It's simply the esthetic question," he says. "It just doesn't look right to see rivers of that color."

Bleached kraft pulp is an aqueous suspension of cellulose fibers extracted from wood, used to make paper and paper products. The dark color originates mainly in the bleaching process, where lignin, a natural wood component, is broken down.

Wilson, with co-operation from pulp mill officials and other government agencies, is trying to determine how to remove the color from the discharge before it enters the river, so new government standards may be set. The work is the first stage of a four to five-year project.

"The reason we got into this is that there will be other mills built in Alberta to process wood products, and we want to have available the best technology for wastewater treatment."

Later, Wilson will examine the tastes and odors of treated pulping effluent, keeping in mind that any future pulp mill discharge in, for example, the North Saskatchewan River, could contribute to the taste and odor problems already plaguing Edmonton's drinking water in the spring.

"We're attacking the color problem first because it is the most obvious and easy to deal with," Wilson says.

Wilson's team has tried three color-removal techniques, all of which were 80 to 90 per cent effective in the laboratory. First, aluminum and calcium salts were used to precipitate color-causing chemical compounds. At a pulp mill, these compounds could be treated separately and disposed of, and the wastewater sent on through traditional biological treatment.

Second, the wastewater was "bleached" with chlorine or hypochlorite, a form of chlorine used to disinfect swimming pools. Third, fungi were used to degrade the color compounds. This biological treatment process is "more revolutionary... and it's likely to be more expensive," Wilson says.

Which brings us to money. Now Wilson must look at each technique and determine "how much a ton of pulp would increase in cost if that process were applied. As with all pollution control, cost is an overriding factor. Obviously, we could reduce the color and produce distilled water, but that would be... an idiotic extreme. If we required Procter and Gamble to do that, they would be out of business."

Ronnene Anderson, a former journalist, is an Edmonton freelance writer.

R.C. MacKenzie

Plume Tracking

Researching the air environment poses special problems.

ALBERTA RESEARCH COUNCIL

When I say "go", grab a handful of air and tell me what's in it. Is it just oxygen and nitrogen or does it also contain other things like dust, pollen and car exhaust? If so, how much? OK, now release the sample, run after it and grab it again, making certain you have scooped up exactly the same chunk of air.

If you can imagine the difficulty of this task, then you can appreciate the obstacles that were overcome by a group of scientists who sampled smokestack plumes near Fort McMurray. To further complicate the problem, they were chasing their handfuls of air in an airplane travelling at 280 km per hour.

In a project jointly funded by Alberta Environment and the Alberta Research Council, scientists are trying to understand what happens to the pollutants emitted by the smokestacks at the Suncor and Syncrude plants. The question is not merely one of determining the chemical composition of the plume but also finding out where these chemicals go, how they change over time and whether or not they somehow interact with the atmosphere itself.

Until recently, most attempts to answer these questions involved taking samples of chemicals as they fell back to earth. From this information, researchers tried to piece together theories to explain what happened between the time substances were emitted from a stack until they reached ground level. But in the Fort McMurray study, techniques were used that very few scientists have tried.

Specially Instrumented Aircraft

The airborne sampling is done using a rather unusual looking aircraft based at Red Deer Industrial Airport. The aircraft has a long, slender pole-like device protruding from its nose. Slung under its belly are four metallic cylinders and mounted on one side of the

GERRY RASMUSSEN

BILL MCKEOWN

Marianne English

fuselage is an array of odd-shaped objects just behind the co-pilot's window.

Originally, the plane was a standard Cessna Conquest executive aircraft, but it has since been outfitted with special instruments worth $700,000. The craft, which is owned by Intera Technologies Ltd. of Calgary, is used 90 days a year in Alberta Research Council's ongoing hail project. But at other times the aircraft's special capabilities can be used for projects such as plume tracking.

The four cylinders suspended below the Conquest's belly are particle probes, each of which has a different size opening to admit airborne particles of various sizes. When bits of smoke or ice crystals enter a probe, they pass through a laser beam. This causes the particle's shadow to be recorded inside the cylinder in digital form and then transmitted to an on-board computer where the information is stored.

Particle probes allow scientists to observe some of the pollutants that are in a plume but they are also essential in determining whether or not some pollutants may be responsible for localized precipitation.

Pollutants Cause Snowfall in Winter

Dr. Marianne English, a cloud physics specialist at Alberta Research Council, who is project manager for the plume tracking study, described one way that pollutants might interact with the atmosphere.

"Pollutants can speed up or initiate normal precipitation processes. You can get ice or water droplets to grow around them. This leads to precipitation in the form of snow or rain so we're watching to see whether some form of inadvertant weather modification might be occurring downwind of the smoke stacks. On the other hand, if the plume comes into contact with clouds, the pollutants might be moved upward in the atmosphere or otherwise redistributed."

Indeed, there is evidence that such phenomena are occurring. During a series of flights in cold, stable air in December 1983, the aircraft encountered ice crystals being formed immediately below the plume.

"It was one of those chance encounters," said Ken Grandia, Intera's meteorologist-pilot. "I had decided to drop below the plume so I could fly directly back toward the stack when all of a sudden the particle probes encountered all sorts of ice crystals. We could see changes in their shape, size and concentration. This sort of thing has been speculated about by others, but no one has ever reported seeing it."

Added Marianne English: "Those ice crystals resulted in snow falling to the ground within a few kilometres of the stack."

This has aroused English's curiosity because now she wonders whether similar behaviour is occurring during summer months. Investigations during the June 1984 flights were aimed at trying to answer this question. The final outcome won't be known for several months as that is usually how long it takes to interpret all the data gathered during 10 days of sampling.

Meanwhile, Dr. Lawrence Cheng, the project's principal scientific investigator, says the three, 10-day series of flights already flown since March 1983 are providing other useful information.

By means of a "sampling manifold" attached to the side of the aircraft, outside air from the plume is brought inside the airplane where it undergoes analysis. Some pollutants in the air are collected on filters for later study after the aircraft has landed. But, on-board instruments can give instantaneous measurements of sulphur dioxide and oxides of nitrogen. By taking samples of these gases at various distances from the stack, changes in concentration can be observed. As well, if these chemicals are being changed into other substances, these transformations can be measured at the same time. This information is useful because it can be used to predict how far from the stack certain substances might fall back to earth in one form or another. These predictions, however, are complicated by the fact that pollutants are transported by local winds which can vary in direction and intensity.

Getting to a point where reliable analysis results could be obtained while the aircraft was flying turned out to be another challenge.

A Game of High Speed Tag

The only way researchers could say with any certainty what was happening to pollutants as they moved tens of kilometres away from the stack was to devise a method of sampling small parcels of the plume over

Alberta's brown domes

Despite continual one-upmanship contests between Calgary and Edmonton, there's one thing they both have in equal doses.... brown smog. It is particularly noticeable in wintertime. The disagreeable stuff, which can hang over the cities like a dome, is caused by automobile exhausts.

According to studies funded by Alberta Environment and conducted by Eric Peake at the Kananaskis Centre for Environmental Research, a chemical compound called peroxyacetyl nitrate (PAN for short), which is formed when sunlight reacts with nitrogen oxides, is the culprit. PAN affects people by irritating exposed skin and causing eyes to water.

PAN measurements were first made in Calgary from a downtown monitoring station 10 metres above ground level.

Noted Peake: "We can observe increases and decreases in PAN concentration that parallel buildup of traffic in the city during the morning and then movement of cars out of the city in the late afternoon. There is a one or two hour delay between the time traffic volume is at its peak and the greatest concentrations of PAN are measured because the photochemical reaction takes place over time. Maximum concentrations occur around noon hour."

The highest concentrations measured in either city were seven parts per billion which may not seem like much, but some people are sensitive to PAN at concentrations of about 10 parts per billion. Nevertheless, Peake noted that most people don't notice any effect until concentrations reach 50 parts per billion.

"The rate of PAN formation is a function of sunlight and temperature," said Peake. "In the winter, we get temperature inversions that trap automobile emissions, causing pollutant concentrations to rise. But, because temperatures are low and we don't have much sunlight, PAN concentrations are not much different than in summer. The difference in summer is we seldom get inversions even though temperatures are higher and there's more sunlight.

Peake said the greatest amounts of PAN are produced in spring and fall, with fall being worse because spring winds tend to sweep it away.

The implications? "Most people need not be concerned yet," said Peake, "but as automobile population increases, more people could be affected."

— *R.C.Mackenzie*

and over again, each time a little farther downwind than the previous measurement.

The problem, as described by Dr. David Rogers, an Alberta Research Council cloud physicist, is "like dropping plastic jugs in a river and then using a canoe to keep going back to them, one by one as they float downstream." But the analogy is not quite exact because a person can *see* the jugs. How does one *see* a parcel of air?

The answer is you can't, but it is possible to make some very good estimates about the locations of those air parcels if the aircraft's position relative to ground reference points is known at all times and if it is assumed that the plume and the aircraft are being carried along by the same winds. By using an inertial guidance system — a navigation device normally found on large, commercial airliners — and a computerized referencing program (affectionately called "Homing Pigeon"), scientists were able to tell where they were at any time relative to those big handfuls of plume they wanted to grab.

Once that problem was mastered, they were faced with another challenge.

High Speed Analysis

The aircraft travels forward at about 70 metres per second. Because it usually passes through the plume at right angles, the plane may be inside the plume only 10 or 15 seconds near the stack and perhaps 45 seconds at distances of 50 kilometres downwind. Conventional instruments that might have been used to analyze the samples being scooped up by the aircraft can only handle one sample every 20 to 40 seconds. At that rate the aircraft could be in the plume and out again before the analyzer was ready for the next sample.

Pollutants can speed up or initiate normal precipitation processes. You can get ice or water droplets to grow around them.

"That's why we modified our analyzers so they could accept samples at the rate of 10 per second," said Eric Peake, a chemist at the Kananaskis Centre for Environmental Research in Calgary, who is responsible for the chemical analysis aspects of the project. "We had to sacrifice some of the instruments' sensitivity to the substances they were analyzing but it was either that or settle for very little useful data." Peake has found that

Instruments aboard the plume tracking aircraft can give instantaneous measurements of sulphur dioxide and oxides of nitrogen.

Alberta Forest Service species trials at reclamation research site at Cadomin, Alberta (right).

sensitivity isn't all that important, however, because pollutant concentrations are high enough that analyzers have no trouble detecting them. Even so, the "high" concentrations Peake is measuring are in the parts per million range.

What Happens to Sulphur Dioxide?

So far, Peake has been able to observe reductions in the concentration of sulphur dioxide as it moves away from the stack, some of which is due to its conversion to particulate sulphate which can be collected on filters inside the aircraft.

"We're getting consistent conversion rates of sulphur dioxide to sulphate at about three to six per cent per hour," Peake added. "We also notice more sulphate is formed on the edges of the plume than on the inside."

What do all of these observations mean? How do they relate to the project's objectives of trying to establish whether environmental damage is occurring at ground level?

DAVID ROGERS

Effects on Vegetation

"It's just too early to tell if the plume's constituents are affecting vegetation," said Dr. Allan Legge, a biologist at the Kananaskis Centre for Environmental Research. "I know that probably sounds like a scientist trying to justify his job, but the truth is it takes a long time for some of these effects to show up in trees, which is what I'm looking at. And, of course, that assumes that effects will actually appear. They may not, depending on the concentration of pollutants, the length of exposure time and a whole host of factors having to do with soil chemistry, movement of groundwaters.... this is a very interdisciplinary field we're in and it requires knowledge of many sciences."

Legge pointed out that it would be nice to answer the question of whether people are being harmed by airborne pollutants (see sidebar) but he notes this represents a very complex problem.

"Trees at least stay put in one place," said Legge, "so if you're looking for effects that take place over extended periods of time, a tree isn't going to get up and walk away on you. People, on the other hand, tend to do that. Besides, the human system is far more complex than a tree's, so to measure any effect on people and say 'this happened because of pollution' is incredibly difficult."

"Even if vegetation is found to have been harmed in some way, questions still have to be answered that relate to all the processes that could take place within a plume such as how far pollutants are transported, what changes they undergo, how they get deposited on earth and what atmospheric interactions are taking place. People have to understand we don't know whether spending millions of dollars on pollution control devices is the most effective way to remove pollutants from the plume. The kind of scientific evidence we're looking for will take years of sampling and analysis."

Bob MacKenzie is an Edmonton freelance writer and researcher specializing in science and technical writing

Sharon Adams

Reclamation Research

A key element of land conservation.

PAUL ZIEMKIEWICZ

In 1963, U.S. President John Kennedy enthralled the western world with his dream of putting a man on the moon. His idealism heralded the race to the moon; it took billions of dollars and six years before the dream, which had outlived its dreamer, was realized.

That year in Alberta, the 1963 Surface Reclamation Act was passed, and the reclamation race was on; but its gains, too, have been measured in small steps and occasional giant leaps.

With public policy to ensure reclamation, and with advances in research, there is little doubt reclamation will also reach the heights imagined by its dreamers.

Today, land must be as productive after reclamation as before.

Initially, mined areas were required to be levelled and contoured for better drainage and to make future farming possible. The 1973 Land Surface Conservation and Reclamation Act increased requirements until today, land must be as productive after reclamation as before.

Reclamation research has helped make this possible.

To keep on top of rapidly-developing research, the Alberta Land Conservation and Reclamation Council, which regulates surface disturbances from such things as mines and pipelines, established the Reclamation Research Technical Advisory Committee (RRTAC) in 1978. In the intervening six years, RRTAC has spent $6.7-million on 46 reclamation projects. And industry has increased the total through its contributions to joint research projects.

Committee chairman Dr. Paul Ziemkiewicz says RRTAC is a good example of both applied research and the benefit of government-industry co-operation.

"The advantage of joint industry and government effort is that it strengthens the communication. All points of view into the research process are made available to the regulatory agencies, and everyone has access to the best information."

In addition, "the technical transfer from research into practice is strongly enhanced," meeting one of the concerns stated by the Research and Science Advisory committee in its science policy statement issued early this year.

RRTAC also minimizes overlap among government departments involved in reclamation. The committee's eight members represent the departments most interested in reclamation (agriculture, energy and natural resources, environment) and also the Alberta Research Council.

Its job, he says, is "identifying the most efficient methods of achieving reclamation in Alberta."

RRTAC is interested primarily in applied research: finding newer and better ways to solve problems in reclaiming lands disturbed by such industrial activities as mining.

Most of the province's industry (and consequently, reclamation) is located in three major biophysical regions. The plains, where the bulk of the province's agricultural land is located, is the site of large surface mines which feed electrical generating plants. The mountains and foothills, prized for their recreation, forestry, wildlife and watersheds, also support metallurgical and high quality thermal coal mines. In northeast Alberta, oil sands mining and extraction plants have joined the more traditional uses, forestry and wildlife.

Ziemkiewicz identifies groundwater maintenance, revegetation and soil reconstruction as major concerns in all regions. In addition, each region has its own particular problems.

The Plains

In the plains region the coal industry and RRTAC have joined forces in The Plains Coal Reclamation Research Program (PCRRP). Through its two projects, the Plains Soil Reconstruction Project and the Plains Hydrology and Reclamation Project, the PCRRP hopes to find methods to rebuild agricultural soil and trace what happens to groundwater during mining and after reclamation, to later maximize agricultural potential.

Mining poses two basic reclamation problems on the plains, Ziemkiewicz explained in RRTAC's 1983 annual report. First, to get at the coal seams, the top layers of soil, bedrock and glacial deposits must be removed, then re-used in reclamation. Much of this material cannot sufficiently support plant growth. In addition, the coal seam is the major source of domestic water in many plains areas and acts as a drain for the land above. Mining and removing the seam cannot help but affect the water system.

Ziemkiewicz says other plains concerns are subsidence, timing the replacement of topsoil to minimize reclamation expense and work, determining how crop slope angles will affect salt movement and finding the best methods of rebuilding soils and subsoils.

R.L. MCKEOWN

Paul Ziemkiewicz

Les Panek

Les Panek, head of Monenco Ltd.'s soils/ reclamation group, and project manager of the Highvale Soil Reconstruction Project, is trying to answer two of these questions. Grain and forage crops are being grown on three acres of reclaimed Highvale surface mine land under different conditions to determine subsoil depth and plot slope for optimum crop growth.

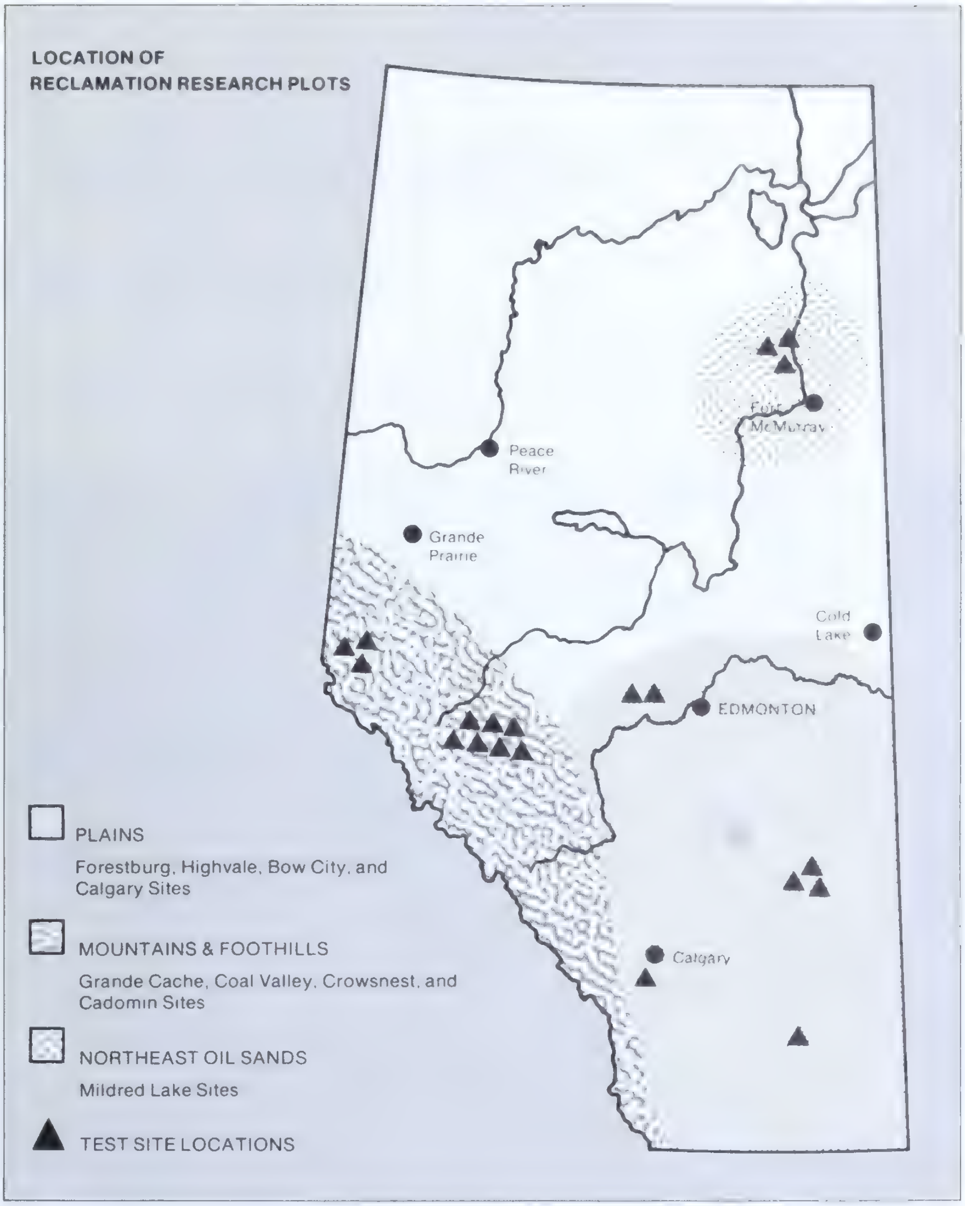
Costs of the joint Highvale project, which could reach $1-million by completion, are shared by TransAlta Utilities, which paid for site construction, and RRTAC, which picks up plot monitoring costs.

In the subsoil trials, he says, researchers want "to determine the optimum depth of subsoil required on land to be reclaimed to agricultural productivity." The slope trails will "examine the moisture relationship — how moisture is accumulating or dispersing down the slope, or infiltrating into the plot."

Mined-out Highvale land is made up of solonetzic soils which are "very difficult to reclaim" due to high levels of sodium which impede growth. Researchers hope to tie moisture movement with migration of sodium from mine spoils, finding out which direction the sodium is moving. "If up, how far it migrates will determine the depth of subsoil required for successful reclamation."

Preliminary results from the two crops harvested so far (the trial will continue to 1987) show water is accumulating at the point where the minespoil and subsoil meet, indicating water, and the salt it carries, may not move downwards. Whether the water will move up, and how far (and how deep subsoil must be to minimize effects of the salt) will be determined over the next four years.

So far, Panek reports, yields have been highest for forage crops grown on half a metre of subsoil, and cereal yields have been greatest on the one metre depth. "The implication is more subsoil is needed for cereal,



less for forage crops."

The slope trials have shown that moisture is greatest in the lowest soil of northern slopes. Panek says if salt is accumulating there, "the implication is we would want to avoid depressions in reclaimed land."

Steve Moran, group leader of the landscape processes group of the terrain sciences department of the Alberta Research Council, says Plains Hydrology and Reclamation Project researchers are trying to identify changes in groundwater after mining as well as the sources and release rates of salt and other contaminants. In addition, researchers are developing the ability to identify, through sophisticated computer modelling techniques, what changes will result from mining.

It may be possible in future to examine minespoil and predict how serious a salinization problem would occur after mining, and what should be done to minimize salt damage.

Early results of the studies, he says, show losing the drainage supplied by the coal seam may result in an elevated water table which may bring salts to the surface. This may mean reclaimed land must be sloped to allow for drainage, and to protect the higher land from salt.

Northeast Alberta

RRTAC and the industry's Oil Sands Environmental Study Group have formed a joint reclamation research project which has identified three priorities: woody plant research, soil reconstruction and equipment development.

Ziemkiewicz's report notes that after the 25-year life of an oilsands plant, a 22- to 31-square-kilometre tailings pond is left containing about 360 million cubic metres of sludge. Remaining liquid indefinitely, the sludge is stored in dikes made of tailings sand 55 to 100 metres high. The sand has no plant nutrients and drains rapidly, so material such as muskeg and mineral overburden will be added to begin soil development.

Pits left after mining will be filled with tailings sand and dumps will be constructed for overburden, then reclaimed.

Reclamation of oil sands mining sites requires development of self-sustaining, erosion-free cover on tailings pond dikes and return of tailings sand storage and overburden dumps to productive forest.

But poor soil nutrients will make reclamation difficult.

Bob Danielson, a biology research associate at the University of Calgary, is in the middle of a five-year study of the "effects and potential application of beneficial fungi."

Researchers wanted to find if certain fungi found in the roots of trees can improve the rate of growth of seedlings planted on poor soil by improving the amount of nutrient the tree can take from soil. Two years ago the roots of jack pines on an experimental plot on the Syncrude site were innoculated with different fungi and growth improvement noted.

"The nutrient status of many reconstructed (oil sands) soils is poor. The solution in the past has been to pour on fertilizer." Innoculating the tree roots with beneficial fungi may make the trees self-sufficient, cutting down on fertilization costs.

The Mountains and Foothills

The mountain and foothills region is the last of the three geologic reclamation areas to have an industry-government joint research effort. This summer RRTAC and The Coal Association of Canada began a three-year, $200,000 jointly funded research project to study the hydrology and plant and soil regimes of the region.

Regulatory agencies will be able to use this research for developing guidelines for commercial forestry on land reclaimed from mining, much of which was previously used by the forestry industry.

The mountains and foothills present

Inspecting foothills reclamation site.

JIM PEARCE AFS

special difficulties: some sites will be hostile to reclamation.

Con Dermott, director of reforestation and reclamation for the Alberta Forest Service, says the foothills and mountains reclamation priorities are revegetation, erosion control, watershed maintenance and reestablishment of both forest and wildlife to pre-disturbance productivity.

Greatly varying conditions will make reclamation difficult, Ziemkiewicz's report says. While some sites have gentle terrain and usable soil, others have steep slopes and rocky spoil. Climate can vary from good conditions for plant growth to a very short growing season. In addition, reclaimed mountain and foothill land will not be managed as intensively as reclaimed agricultural lands, so reconstructed soils must support plants without need of indefinite tending.

Dermott says the reclamation research projects have spanned the range of reclamation problems. Erosion is a major concern, affectng forestry, wildlife and the water regime. Researchers are trying to find the best native and exotic species of grasses, trees and shrubs to control erosion, to control watersheds to regulate water flow and contain silt and to find the best slope for reclamation of coal mine dumps.

Researchers are also delving into soil reconstruction and revegetation to improve low-nutrient soil and to find the best species for revegetation. Others are trying to find plants that will make the most of what's available in the environment by improving plant propagation, improving root zones over rocky, nutrient-poor soil and capitalizing on the natural fertilization system.

"Mining is a temporary land use," Ziemkiewicz says. "Having extracted the mineral, we want to get back to the original land use."

Sharon Adams is a Calgary journalism instructor and freelance writer.

Jim Wilson

Acid Deposition in Alberta

The most comprehensive multidisciplinary study ever undertaken in Alberta.

ALBERTA RESEARCH COUNCIL

Acid Rain. It's one of those marvellous phrases that plays on our imaginations as well as our intellects.

In Central Canada entire lakes have been declared "dead" because of pollution from acid rain. Landscapes are affected — and so is our food chain.

But irrefutably identifying the sources of acid-forming emissions is a tremendously difficult task. The United States government, for instance, has insisted on seeing mountains of hard, cold evidence before it will admit that American industries are creating an acid deposition problem in Canada — and in fact, Canada has recently retaliated by buying space shuttle capacity for a special acid-detecting satellite it hopes will provide some of that proof.

Whether Alberta has a similar acid deposition problem or not is a frequently-debated issue, and a joint government-industry program designed to produce results acceptable to the most skeptical scientist is now well under way.

"Assuring credibility of results is extremely important in this program," says Ken Smith, government co-chairman of the $8 million, seven-year Acid Deposition Research Program and an Alberta Environment assistant deputy minister. "And when you consider that conducting any sort of environmental research is extremely difficult to start with, you can start to understand how carefully we have to manage it."

Studying the environment is something akin to performing magic: what you see now isn't necessarily what you'll see in a few seconds. In fact what you see now isn't necessarily what's really there.

Studying the environment is something akin to performing magic: what you see now isn't necessarily what you'll see in a few seconds. In fact what you see now isn't necessarily what's really there.

Imagine an outdoor display case whose bottom is shaped like Alberta in three-dimensional relief and whose walls are of transparent screening to permit free flow of air, water and pollutants from the space surrounding the case.

Such a display case provides a model of the province's environment, and that environment at any given moment is composed of whatever exists inside its boundaries. But the contents of our display case are also in rapid flux: as water, air, even solar radiation flow freely in from every direction through the surrounding "screening" — the political borders — the environment changes.

The momentary environment is also constantly altered by industrial and social activites occurring inside the boundaries as we go about our daily business. We create pollutants — and we also remove pollutants (though not always the same ones).

And not to be forgotten: our "screening" is transparent in both directions. We pass along our own environmental alterations to those areas outside our "display case" boundaries.

MARTHA JONES

In the real-life situation of Alberta's Acid Deposition Research Program (ADRP) that display case model becomes even more complicated, because every defined study area within the province must be looked at as comprising its own mini-environment, affected from without and within and also altering its own surroundings.

ADRP is a co-operative project of government and industry designed to establish the sources, quantities and affects of acid deposits in the province. (The common phrase "acid rain" is actually an incomplete description of the problem, because windborne acid-forming substances are deposited on the landscape even when it isn't raining. ADRP will consider all deposition mechanisms.)

The project will be the most comprehensive multidisciplinary study ever undertaken in Alberta, and is intended to provide the final current word on whether or not Alberta has an acid deposition problem.

ADRP will commission studies on oxides of sulphur and oxides of nitrogen, and research approaches will be divided into two main areas: those involving biophysical matters — pollutant sources and their basic effects; and human health.

In order to give the program the highest degree of credibility and to maintain an arm's-length objectivity for its participants in terms of research project selection, ADRP held two special workshops to which internationally-known specialists were invited and asked to recommend both methodologies and study areas.

A biophysical workshop was held in September, 1983 and a human health workshop in January, 1984. Little information was released to the public following those workshops, however, and in response to some adverse reaction from media and environmentalists, a third workshop, on ADRP communications, was held in May. A compilation of the reports of those three workshops was eventually published and released to the public at the end of June.

"The first two workshops identified potential research areas which would involve about $15 million," says Ken Smith, "and the members' committee will have to prioritize them to fit our $8 million budget."

The biophysical workshop recommended selecting of a number of sites in the province where studies of air quality, precipitation quality, vegetation effect, soil and aquatic research would be carried out, looking at dry and wet depositions of sulphur and nitrogen oxides and ozone, all of which tend to combine with themselves and other compatible substances to form acidic compounds.

BILL MCKEOWN

Ken Smith

The human health section recommended research involving epidemiological studies of selected communities and occupational situations, clinical service and field research programs involving community participation, human clinical research and animal toxicology, and behavioral-environmental health issues.

Smith says ADRP will contract out virtually all of the selected projects to private consultants and universities, again to maintain the program's credibility. "That doesn't mean we won't use Alberta scientists," he says, "— in fact we will. But this won't be an in-house activity."

In its concern for credibility, ADRP has also accepted workshop recommendations that all research results be screened for scientific integrity by outside scientific peer committees before they are released. "We want as high a level of confidence in the results as we can possibly get," Smith says. "And there's another advantage to this approach — it's a pretty unique program, and we've attracted interest from some very high-calibre scientists."

Ron Findlay, the industry co-chairman of ADRP and AMOCO Canada environmental affairs manager, says he is pleased with both the program's organization and its progress to date.

"For the first time in this area of environmental concern I think we're all paddling with the same set of paddles," he says. "As far as research, planning and execution, we have an exceptional approach, and it looks like we should be able to come to sound conclusions as to the impacts of these sorts of pollutants."

Findlay adds that ADRP will have international implications. "The technology we're developing, the techniques that we're using – it will all be applicable throughout the world. Of course the ecological assessments themselves will apply only to Alberta, because different areas have different environmental and biological conditions."

While ADRP has been in the developmental stages for several years, one impetus for its initiation has been the federal government's announced intention to reduce Canada's emission of sulphur and other acid-forming substances by 50 per cent during the next two decades — at an estimated cost in excess of $10 billion.

"Alberta already has among the world's most stringent regulations controlling industrial emissions," Findlay says, basing his claim on reports published by the United Nations and the World Health Organization. "In Alberta we're currently averaging a 97.3 per cent sulphur recovery — and we hope with results from our research that we'll be able to indicate to the federal government that they should pick up their 50 per cent in Ontario, where the recovery rate is under 80 per cent."

Inco Ltd.'s Sudbury, Ont. plant is considered North America's largest single source of sulphur dioxide emissions, and the Noranda Mines Ltd. smelter at Rouyn, Que. is the continent's number two producer.

Nevertheless, Findlay says, ADRP studies should answer concerns even about the 2.3 per cent of sulphur and other emissions that still emanate from Alberta smokestacks.

"We have to ask whether the environment is accumulating the pollutants we're putting into it, or assimilating them. If that 2.3 per cent is accumulated, then it's an indication that we may have a problem to deal with — and that we'll have to do something to clean up our emissions still further, even though the expense would be in the billion dollar range."

Both Smith and Findlay are hopeful some of the proposed research projects that will have to be dropped for budget reasons may be picked up by industry, government departments and agencies or universities. There are about 25 potential studies proposed by the two scientific workshops.

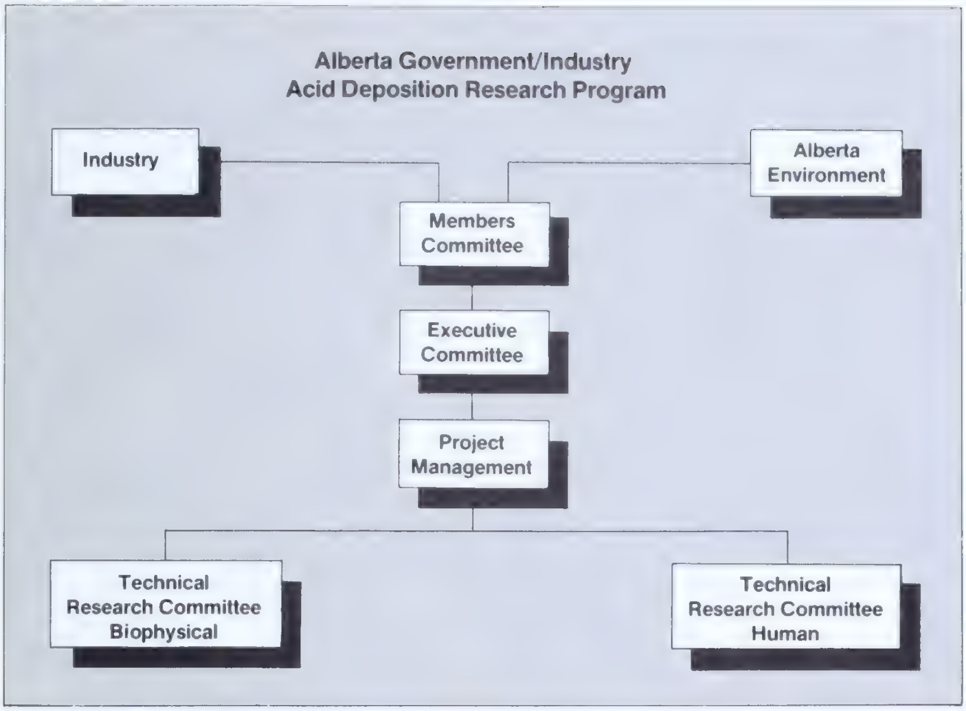
"All of the proposals have merit," Smith says. "It's simply a matter that we don't have sufficient funding to pay for them all at the present time."

And Dr. Bob Rogers, government co-chairman of the ADRP human health committee and manager of the Alberta Worker's Health, Safety and Compensation inhalation toxicology program, believes that at least some of the studies should be selected simply because their findings will bear heavily on the effectiveness of others in the multidisciplinary approach, because much of the program's effectiveness will depend on how well the various projects undertaken fit together and further one another.

Rogers is also concerned that while the program should be as open to public involvement and scrutiny as possible, research data should not be released prematurely or piecemeal, which could result in misleading expectations.

"Acid deposition is not just a local issue,"

Continued on page 29


Alberta Government/Industry
Acid Deposition Research Program

Beginnings

The program had its beginnings when the Alberta Petroleum Industry Government Environmental Committee (APIGEC) was formed in 1972 by Alberta Environment, the Energy Resources Conservation Board, Alberta Energy and Natural Resources and the Canadian Petroleum Association. In 1979 APIGEC established a Steering Committee on Acid Gases in the Environment (SCAGE), with the intention of studying the effects of acid deposition in Alberta. SCAGE was quite specifically neutral in its approach: it was to address the concerns of Alberta's petroleum and power industries, as well as those of the government and the public.

Following discussions involving 40 acid deposition specialists from industry, universities and government, SCAGE made its report to its parent body in 1981. The report's most significant aspect was its determination that since all factors contributing to an environment or ecosystem are interrelated, any studies of that environment should be multidisciplinary in scope and totally co-operative in organization.

Future studies of acid deposition, SCAGE believed, should address sources of acid-forming emissions, their transportation paths and dissemination rates, their effects on ecosystems and very significantly, their effects on human health, something almost never before thoroughly investigated on a broad basis.

In April, 1983, ADRP was formed as a result of the SCAGE report. Its members include Alberta Environment (providing 50 per cent of its funding), the Canadian Petroleum Association (34.2 per cent), the Independent Petroleum Association of Canada (5.27 per cent), a power utilities group representing TransAlta Utilities, Alberta Power and the City of Edmonton (total 5.27 per cent), Petro-Canada Exploration Inc. (2.63 per cent), and Nova, An Alberta Corporation (2.63 per cent). In addition, the Alberta Energy Resources Conservation Board and a public representative selected by a number of environmental groups participate as non-voting members.

The program's mandate is to:

(1) Provide a comprehensive understanding of the effects and consequences of acid-forming gases on the environment;

(2) Provide a scientific basis for sound, long-term environmental management and regulatory control with respect to acid-forming gases;

(3) Disseminate such information among members, to the public and to government bodies;

(4) Undertake any research deemed appropriate.

— Jim Wilson

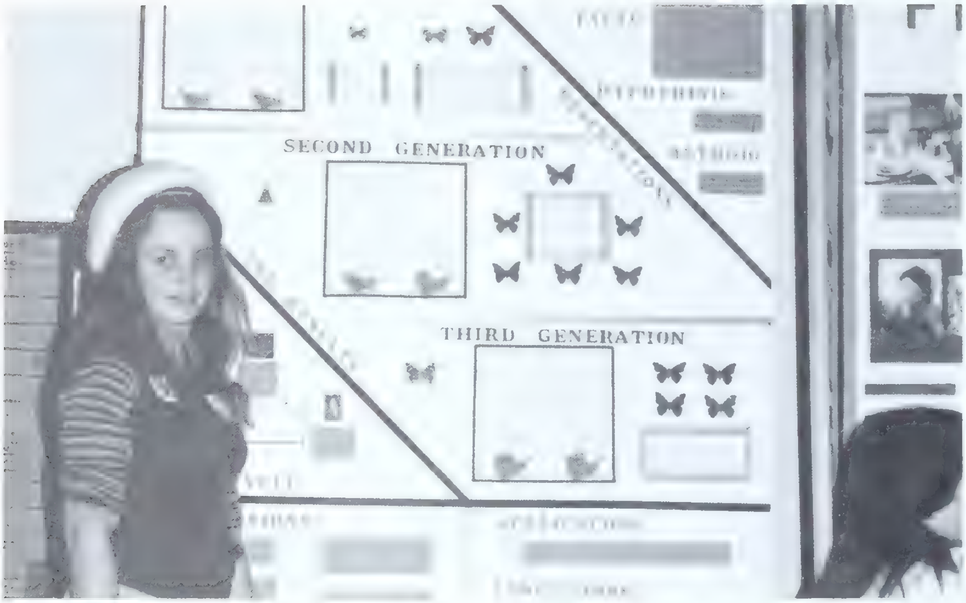
Maryhelen Vicars

Tomorrow's Scientists

Launching a career in science.

Michelle Botting, a winner in the junior life science category at this year's Canada-wide Science Fair (below).

Her father Dr. Gary Botting displaying his work at the International Science Fair in Indianapolis in 1960 (right)



GARY BOTTING

Remember Nancy Drew, the plucky and energetic kid whose amateur sleuthing invariably helped the police nail the villian?

Science, too, has its Nancy Drews, youthful scientists who make up in enthusiasm and bright ideas for what they lack in academic preparation and experience. Like Nancy, whose youth and lack of police credentials don't hold her back as she follows her hunches to the all-important clue, these kids often achieve results which make a real contribution to science.

Remember also, the true story of the young Beatrix Potter. For years she and her brother polished their skills as amateur scientists, enlivening a rather lonely nursery and Victorian schoolroom with the study of a parade of small animals, polishing their amateur naturalist skills. As a young woman, Beatrix approached the eminent botanists of the Royal Botanical Gardens at Kew with a paper and drawings documenting her observations about a certain class of fungi.

Her efforts were ridiculed and ignored — she was young, a girl, an amateur — and so the paper languished half-forgotten in a drawer. It took several decades before scientists in the field "discovered" the phenomena she had already recorded. (Beatrix Potter, of course, put her naturalist's skills to work in a series of children's books, beginning with *Peter Rabbit).*

A modern-day Beatrix would probably be encouraged to enter her work as a project in one of hundreds of science fairs held across the country. There, she would meet other like-minded children, and also established scientists who would take her research seriously.

Dr. Gary Botting was one of the first Canadian students to benefit from the science fair movement, which started in the U.S. in the mid-fifties and in Canada in 1958. A keen amateur entomologist in his early teens, he had developed silk moth hybrids which produced better quality silk. With this work, he won the Ontario science fair and the international science fair in the U.S. two years in a row. Among his prizes were trips throughout the U.S. and around the world to collect specimens and to meet eminent entomologists.

His daughter Michelle shares his enthusiasm for moths and butterflies, and this year won an honourable mention in the junior life science category of the Canada-wide Science Fair, sponsored by the Ottawa-based Youth Science Foundation, for a project on the migration of the Great Painted Lady butterfly. From her school fair, the Grade 7 student was selected to enter the regional fair at Red Deer, where she won in her category and was sent to Ottawa for the Canada-wide fair.

Michelle's project grew out of a family butterfly collecting trip which included following the swarms of Great Painted Lady butterflies from central Alberta to Churchill, Manitoba, making observations about the poorly-understood process which compels this species to make the arduous one-way migration at irregular intervals.

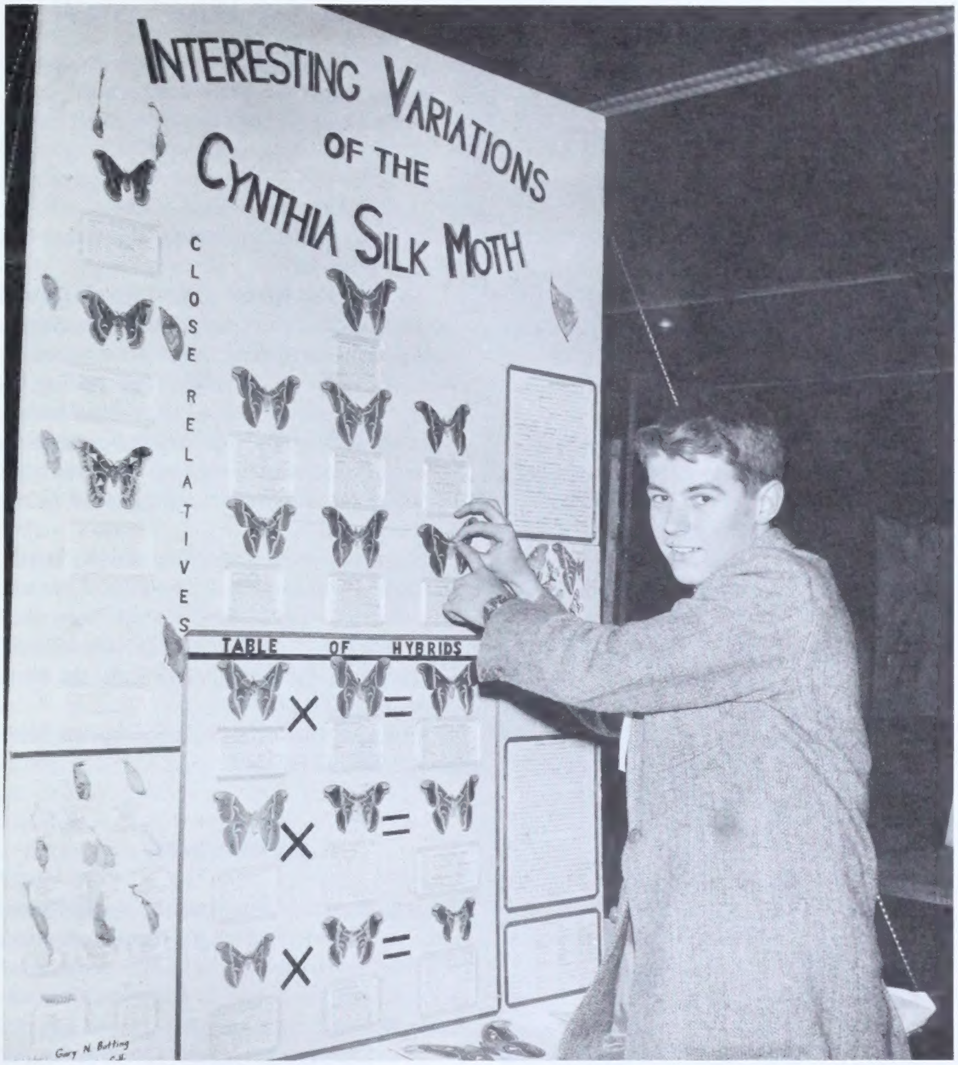
She is already working on next year's project — the classification of Swallowtail butterflies found in the mountains. "You can learn a lot at science fairs," she says, pointing out that her classroom science marks have greatly improved because of the interest she developed in the work of other children.

"Children can make a real contribution through their work, and sometimes not being a working scientist is an advantage.

"Often scientists are not off the wall enough. . ."

The Nancy Drew parallel is Dr. Botting's. "Children can contribute to detective work in science — and it's a lot safer than solving crimes." He believes that children can make a real contribution through their work, and sometimes not being a working scientist is an advantage.

"Often scientists are not off the wall enough, they're too tied to the system they happen to adhere to," he says. Some scientific problems seem to call for the flexibility


INTERESTING VARIATIONS OF THE CYNTHIA SILK MOTH
CLOSE RELATIVES
TABLE OF HYBRIDS
Gary N. Botting

and daring of the amateur.

David Hall, executive director of the Youth Science Foundation, is very enthusiastic about the benefits of science fairs, to students and to science.

"The key thing we want to give young people is the opportunity to develop original and creative scientific work, and this is something that just can't be done in the classroom. We hope to give them a sense of the fun and excitement of the science of the real world."

Often, he says, science fair experience is valuable in launching a career. Canada's first woman astronaut, neurologist Dr. Roberta Bondar, credits her science fair experience with leading her to go into science. Hall says about 80 per cent of participants in the Canada-wide fair go into science, and many of those go into other fields where their science training is an asset.

Often, work done for the senior levels at the fair is of more than academic interest. Three years ago, a student in the Maritimes developed a strain of bacteria which was used to attack the spruce bud worm plaguing eastern forests. This year, there were three projects from western Canada concerned with biological control of mosquitoes.

"It's amazing what some of these kids are doing at the high school level," says Hall. This year's gold medal winner has been working for two years on fetal alcohol syndrome (in which an unborn child is harmed by alcohol consumed by its mother). The latest work identifies the mechanism by which the fetus is affected by alcohol and also a possible way of counteracting these effects.

The projects tend to reflect public concerns, Hall says. A couple of years ago, solar and wind energy were popular. This year, there were several projects on acid rain. Environment-related research of all kinds has been well represented for a number of years.

An important benefit of science fairs is the contact the kids have with each other, Hall says. "The number one thing kids say is important is finding out they are not alone in their interest in science. . . There is so much peer pressure not to be academically inclined.

"It's also very important to show young women that science is just as much for them as for boys."

Maryhelen Vicars, a former journalist, is the freelance editor of *Environment Views*.

Continued from page 27

Rogers says, "it's a worldwide one. People from all over the place are watching what we're doing and will be interested in how we do it and how well we succeed.

"The scientists in the workshops have provided us with the umbrella — with the scope of things we should try to do. Now it's up to the members' committee, and they'll have a pretty hard task, because they have to make the project selections."

Rogers expects a reasonably complete list to be announced in September, and at that point ADRP will advertise throughout North America requesting proposals from scientists and consultants able to take on the specific research selected.

One problem yet to be fully addressed is overall ADRP project management. Is it better to have one generalist in charge of the whole program, attempting to keep everyone in touch with everyone else and meeting all of the critical points on all of the multidisciplinary critical paths, or would it perhaps be better to have an independent manager for the biophysical section and another for the human health section?

The matter is of extreme concern to the members' committee, and in the ADRP workshop report released by the CPA, the executive summary says:

"The probability of success of the research plan . . . is dependent on the degree of integration achieved in its management. It cannot succeed if separated into independent, unco-ordinated sectors."

Another problem has been defining the degree and timing of public involvement in the program, which is what the communications workshop considered. Release of the ADRP workshop proposals report defused much of the public concern in that area, and Smith says there will shortly be a formalized means of releasing information to the public and involving Albertans in the various research projects where possible.

The final, and perhaps in the end most important concern is whether government and industry will take positive action when the final ADRP report is made in 1990 or 1991. And Ron Findlay says he has every confidence that "we're all going to act on it — it won't be swept under the table.

"The finger is being pointed right now at the power, petroleum and transportation industries as sources of pollutants which may be harming the environment. Our (ADRP) agreement is that if problems are identified, industry and government will take action to reduce the pollution load to an acceptable economic, social and environmental level."

Jim Wilson, a former journalist, is a Calgary freelance writer.

A.E. News

Oil Drop

Each year in Alberta, about 18 million litres of used motor oil are discarded in ways which could contaminate the environment — poured down sewers, dumped or burned.

A new program of Alberta Environment's waste management branch is tackling the problem. In Edmonton, Camrose, Red Deer, Calgary, Lethbridge and Medicine Hat, distinctive black and gold OIL DROP signs are posted at about 300 gas stations which offer free collection of used motor oil from the public. The oil collected is cleaned, treated, filtered and, with additives replaced, made into re-usable oil.

OIL DROP

With OIL DROP, the waste management branch hopes to boost the current figure of about 17 million litres which have been collected for re-refining each year in Alberta.

As well as helping solve a contamination problem, a high level of participation will help preserve a non-renewable resource.

Humane Trapping Research

A major research project has begun at the Alberta Environmental Centre at Vegreville to develop and promote humane trapping systems. The project funding is co-sponsored by the Alberta government and the Fur Institute of Canada.

Continuing work undertaken by the Federal-provincial Committee for Humane Trapping between 1974 and 1981, the project will develop and test trap designs which are effective and humane. Intensive research and testing of field-worthy designs must be undertaken before a replacement program can begin. A number of provincial and territorial governments will also provide funding to allow field testing of trap designs.

New Publications

Alberta Environment is updating its publication list. If you would like to be on the mailing list, call or write Communications Branch, Alberta Environment, 12th Floor, 9820 - 106 St., Edmonton, Alta. T5K 2J6 (403) 427-6267.

Here are some recent publications with phone numbers for ordering:

- Alberta Environmental Centre Annual Review 1982-83 — 632-6761
- Draft Information Requirements — Proposed Slave River Hydroelectric Project, April, 1984. Published by the federal and provincial governments — 427-6341
- Major Energy Developments and You — a brochure on the environmental impact assessment process, including hearings — 427-6225
- A new sign for a cleaner Alberta — a brochure on Alberta's Oil Drop program for collecting and recycling used lube oil — 427-5868
- Environmental Education: Government Services for Teachers and Leaders — a guide to environmental education services in the Alberta government — 427-6310
- Environmental Fact Seeker's Guide (revised) — a step by step aid to doing environmental research; intended primarily for students and teachers — 427-6310

Environmental Education Workshops

Workshops to train teachers and youth leaders have always been a popular service of the Environmental Education Resources Branch. In sharpening their teaching skills many participants have found that their own awareness of the natural environment has been heightened.

Starting this winter some workshops will take a slightly different approach by addressing such topical subjects as water quality, acid deposition, chemical and biological control of pests and land use. Jim Martin, head of the branch, feels that more attention to current issues is in keeping with methods of scientific and social inquiry used in the school curriculum.

Speakers, leaders and materials for workshops are provided by the branch. The two-day sessions will be held at the Yowochas Centre, south of Fallis, on Highway 16 west. Participants will be responsible for the costs of room and board.

For more information contact Jim Martin at (403) 427-6310.

Retirement

Eugene Kupchanko, assistant deputy minister of environmental protection services, left Alberta Environment in June to become Vice-President of Cirrus Resource Consultants Inc. in North Vancouver.

Mr. Kupchanko joined the department when it was formed in 1971 and helped draft the provincial Clean Air Act and the Clean Water Act. In 1974 he became assistant deputy minister responsible for the department's pollution prevention and control programs. During his career with Alberta Environment Mr. Kupchanko served under four Ministers of Environment.

Water Use Hearings

Residents of southern Alberta are being asked to present their views on water use in the South Saskatchewan River basin at public hearings this November and December. The hearings will be held by the Alberta Water Resources Commission in Calgary and nine other centres. The schedule is as follows: Calgary Nov 6, 7; High River Nov 8; Lethbridge Nov 12, 13; Taber Nov 14; Vulcan Nov 22; Brooks Nov 27; Medicine Hat Nov 29, 30: Strathmore Dec 4; Hanna Dec 6, 7; Red Deer Dec 11, 12.

After the hearings the Commission will make recommendations to the government on a number of water management issues in southern Alberta, the most important being priorities for water use, how water will be managed to meet those needs and the amount of water that each river in the basin will carry into Saskatchewan.

The South Saskatchewan River basin includes the Red Deer, Bow, Oldman and South Saskatchewan rivers. A 1969 agreement with the prairie provinces and the federal government allows Alberta to consume 50 per cent of the natural flow in the South Saskatchewan each year. The remainder must be passed on to Saskatchewan.

Many of the questions that have to be answered about water use in the basin are addressed in an 88-page summary report and scenarios released by Alberta Environment in August. These documents have been distributed widely in southern Alberta and are intended for public review and as background information for anyone planning to make a submission at the hearings.

Before the hearings start, Alberta Environment will hold public meetings at various locations throughout southern Alberta to explain the information contained in the report. To get a copy of the report, call Alberta Environment's planning division in Calgary (297-8282).

Anyone planning to make a presentation at the hearings is asked to notify the Water Resources Commission and to submit a copy of the brief in advance.

AE News is a new feature of *Environment Views,* highlighting news from Alberta Environment. Anyone with items of general interest about Alberta Environment projects, achievements, staff changes, etc. should contact the communications branch, 12th floor, Oxbridge Place, 427-6267.

Prepared by Jim Martin

Using Environment Views in the Classroom

JAN EDMONDS

The main educational use of this issue of *Environment Views* is that it gives life to the cold, often maligned and misused word "research," giving insight into people and organizations actively looking for answers to problems students can identify with.

This issue is invaluable for the social studies and science teacher in providing case studies of research being carried out on a wide scope in the area of environment. Taken in its entirety the issue defines the breadth of concern that government, industry and concerned citizen groups have in the environment. Taken separately, the articles detail the commitment of the individuals involved, the costs and, perhaps most of all, the time required to answer some fundamental questions about the environment and man's relationship to it.

Environmental Research, Part Two, illustrates very well two fundamental concepts important for use in the social studies and science classrooms.

The first concept relates to the process of awareness to action. Being aware of a problem is not enough to make decisions about the action to be taken to alleviate it. The articles in this issue all focus on the need to obtain solid evidence upon which decisions can be based. Numerous examples are given where erroneous conclusions have been made about the causes of an environmental problem only to be disproven following extensive research.

The second important concept is that of co-operation. In order for research to be carried out information and expertise must be shared, funding gathered, and a co-ordinated program among many elements planned and administered. Each article illustrates that successful research requires the co-operation of government at all levels, industry, the universities and the general public.

If undelivered, return to:

Environment Views
Alberta Environment
9820 - 106 Street
Edmonton, Alberta T5K 2J6

Environment Update

Banff Centre Resource Management Courses

Project Assessment Sept. 30 - Oct 6
The procedures of guiding a project assessment through the site selection and assessment review process.

How to Present Environmental Evidence Oct. 28 - Nov 1
For the resource management professional, this workshop will teach and demonstrate ways of presenting evidence before regulatory boards, commissions of inquiry and courts.

Integrated Approaches to Resources Planning and Management Nov. 25-30
Designed for middle-level and senior professionals in industry and government who are responsible for planning resource development projects.

For further information, please contact Susie Washington, Program Manager, Banff Centre School of Management 762-6137

Twin Butte Times

The Pincher Creek Area Environmental Association and other organizations have begun publishing a newsletter. Any individual or group wishing to submit articles of environmental or other interest may send copy to: D. James Box 2367, Pincher Creek T0K 1W0.

Copies are available from Kerry Lowe, Alberta Environment, Lethbridge, 2nd Floor, Provincial Building, 200 - 5 Avenue, South, Lethbridge, Alberta, T1J 4C7

Oil and Fresh Water

There will be an international conference on *Oil and Fresh Water: Chemistry, Biology, Technology,* sponsored by agencies including Alberta Environment, Environment Canada, the Natural Sciences Engineering Research Council of Canada, and the Petroleum Association for Conservation of the Canadian Environment. The conference will feature eight invited presentations by international experts, followed by two days of contributed papers. The conference will be held at the Westin Hotel in Edmonton October 15-18. For further information and registration contact: Steve Hrudey, Dept. Civil Engineering, University of Alberta, Edmonton T6G 2G7. or call 432-5122.
conference at 284-7429.

Heavy Metals

Heavy Metals in Natural Waters: Applied Monitoring and Impact Assessment is the title of a new book written by Drs. Jim Moore and Sub. Ramamoorthy of the Alberta Environmental Centre in Vegreville. The publisher, Springer-Verlag of New York, describes it as "a highly practical review of the principles and methods of monitoring and assessing heavy metal pollution in natural waters". The two authors also have a book at press on organic chemicals in water.

Environmental Education — International Perspectives

The National Association for Environmental Education is organizing a conference on *International perspectives on environmental education: issues and actions* to be held at the Chateau Lake Louise, October 5-9.

For further information contact Jim Martin, Environmental Educational Resources Branch, Alberta Environment, 427-6267.

CSEB National Conference

The Canadian Society of Environmental Biologists (CSEB) will be holding its 25th annual conference on January 3-5, 1985 in St. John's Newfoundland. The theme is *Environmental Research in Atlantic Canada.* As in the past, the symposium will be held in conjunction with the Canadian Conference for Fisheries Research and the Society of Canadian Limnologists. Further information is available from: Canadian Society of Environmental Biologists — Alberta Chapter, P.O. BOX 12, Substation 11, University of Alberta, Edmonton, T6G 2E0.

Water Resources Conference

The Canadian Water Resources Association, Alberta Branch, is holding its annual conference in Red Deer October 30 and 31. The topic is *Drinking Water Quality in Alberta.* For further information, contact Gus Ribiero, registration chairman c/o ECOS Engineering Services, Ltd. #201, 11830 - 111 Ave. Edmonton 452-0090.

Newsletter

The Land Directorate of Environment Canada has begun publishing a newsletter carrying news items on government policies, legislation, university research, statistics, future projects, conferences, workshops and publications on all aspects of the land resource. For inclusion on the (free) mailing list, write to: LAND, Lands Directorate, Environment Canada K1A 0E7.

Transboundary Issues

The third annual conference of the Northwest Association for Environmental Studies will be held at the University of Victoria Nov. 1-3. The theme is *Across the Border: Transboundary Environmental Issues in the Pacific Northwest.*

Apology

In the last issue, the captions under photographs of Alan Vanterpool and John Defir were transposed. We apologize for any confusion this may have caused.

If you have a short news item of province-wide interest you'd like to contribute to Environment Update, please send it to the editor at the address on the Contents page. The editor reserves the right to select and edit the items.